TECHNOLOGY DEPARTMENT

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Plastics

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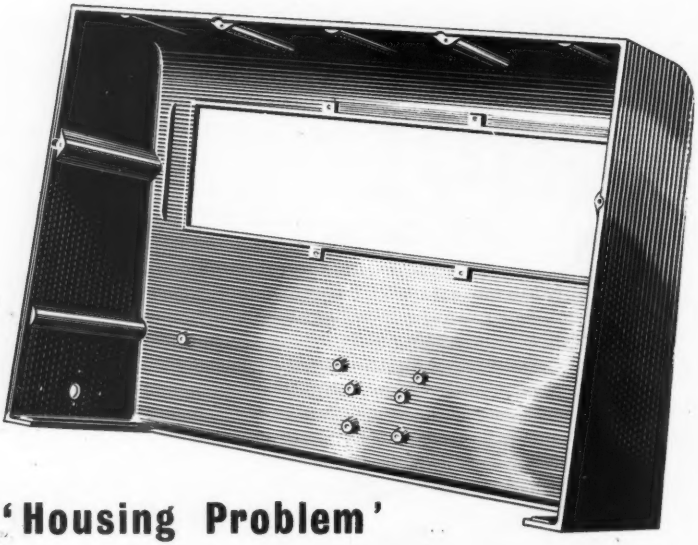

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solved by EKCO Plastics

Ekco technicians are quite at home with difficult housing problems — the more difficult the better. Some of the jobs in current production, for example, involve mouldings weighing 16 lb. and having projected areas of 900 square inches complete. The complicated specification and unusual size (24" x 16" x 8") of the Thermovent Heater casing illustrated go to show that Ekco's resources are more than equal to any moulding problem industry can set.

TECHNICAL DETAILS—*A tool weighing 6 tons mounted on a 1,650-ton press was required for this one piece heater casing. Ample radii and strong concealed ribbing make it proof against cracking or distortion despite constant heat from high wattage elements. Material used is phenol formaldehyde, or, where colours are required, Urea. Brass inserts are moulded in and, altogether, there are 28 moulded bosses for drilling or tapping as required.*

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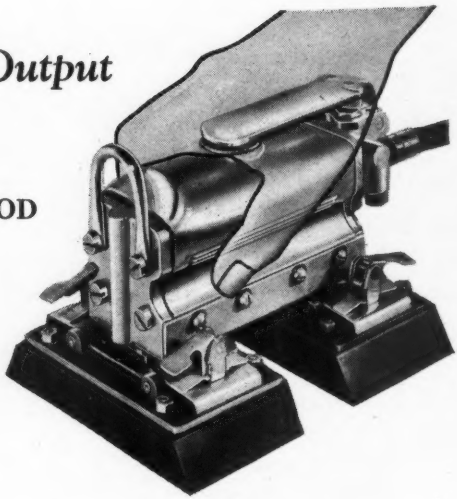

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DROPPED ON TO CONCRETE
without shattering!

Here is evidence of the great strength of "Rockite" 3932 — the nearest thing in plastics to unbreakable moulding material! The "Stabel" selvedge beams, illustrated, have 8-in. flanges in "Rockite" 3932, natural finish, heavy shock-resisting grade phenolic material, bonded on to tubular metal cores with the aid of a synthetic resin adhesive. The complete assemblies weigh nearly 2¼lbs. To test their strength and prove their serviceability they are held shoulder-high and allowed to drop on to solid concrete. They must not crack; they must not shatter. "Rockite" 3932 passes this test with flying colours, because it has an impact strength 2½ times greater than any other phenolic moulding material.

Ask BRP for full information on the uses of "Rockite" 3932 for table tops, trays, furnishings, instrument cases, containers and every application which may be dropped, knocked, or subjected to vibration or general hard handling. *Illustration by courtesy of Stabel Products Ltd., Canley, Coventry.*

ROCKITE
3932

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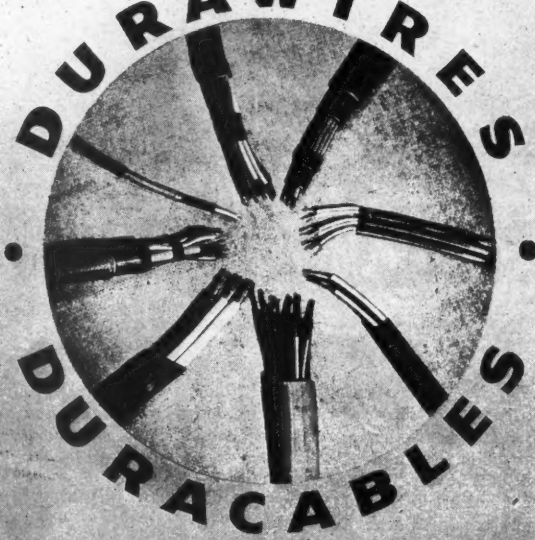

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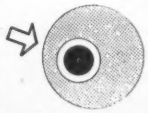

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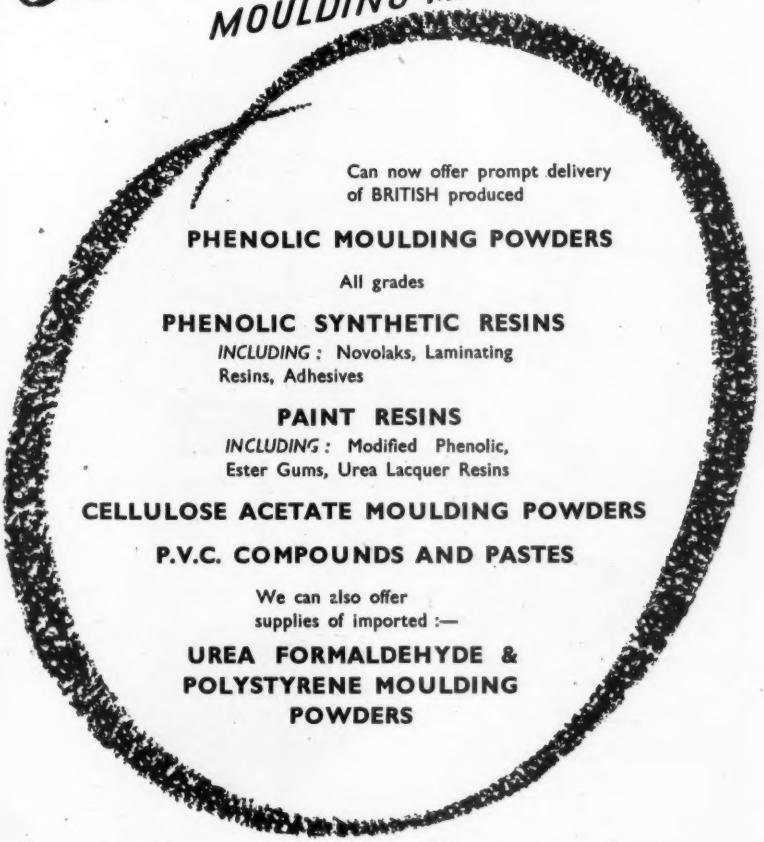

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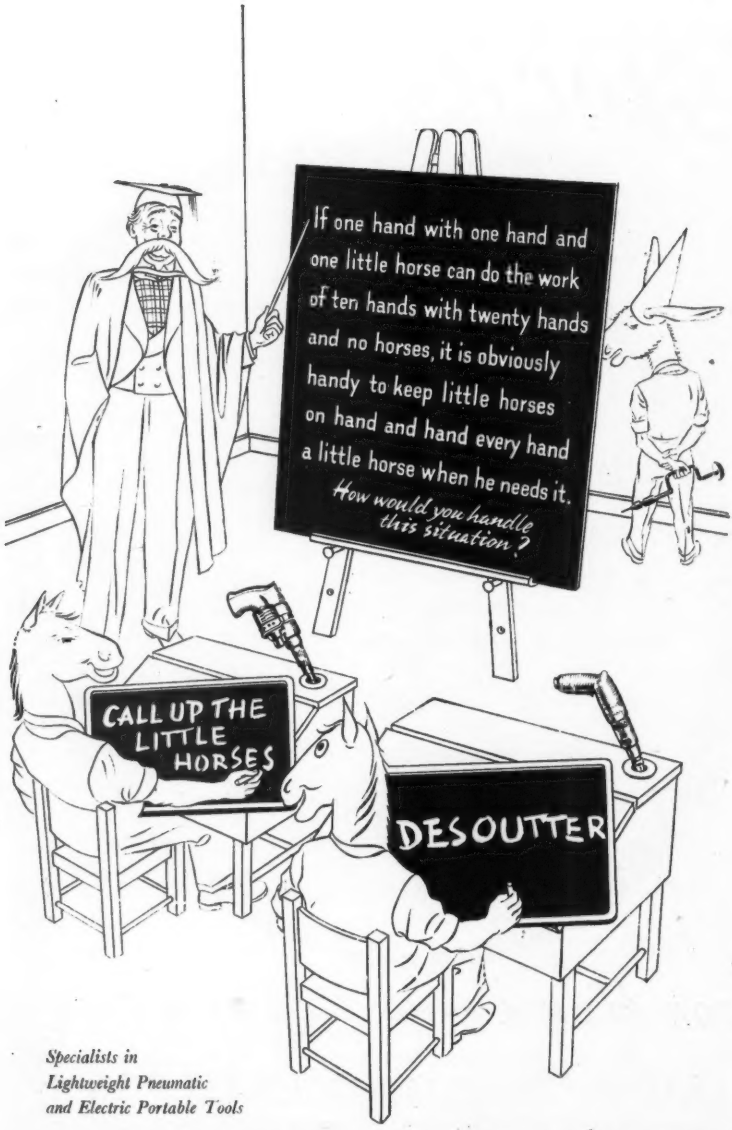
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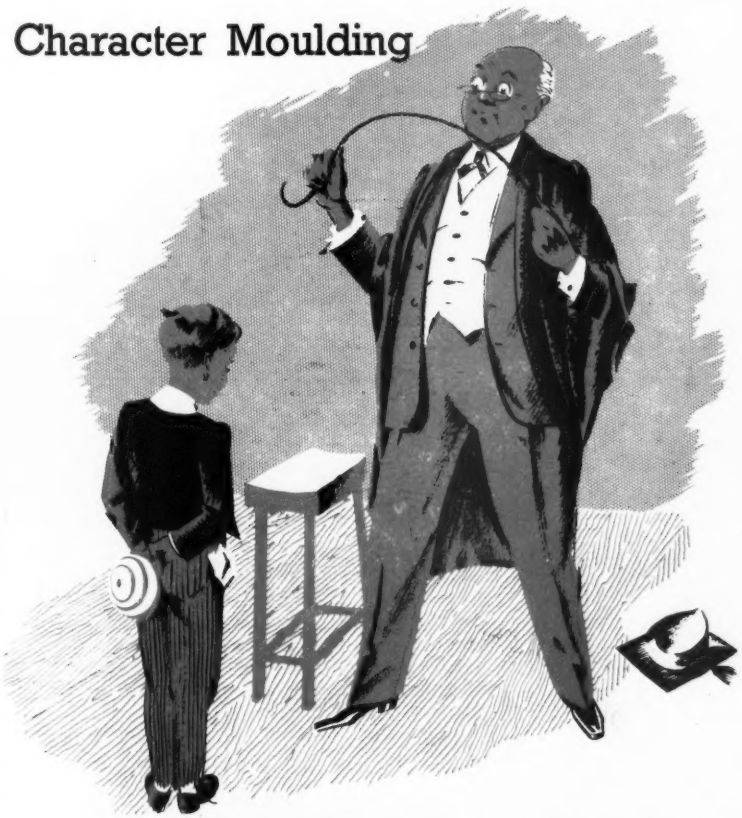

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Tygan can be cleaned with a damp cloth

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● *This is one of the advertisements appearing for Tygan in the furnishing trade press*

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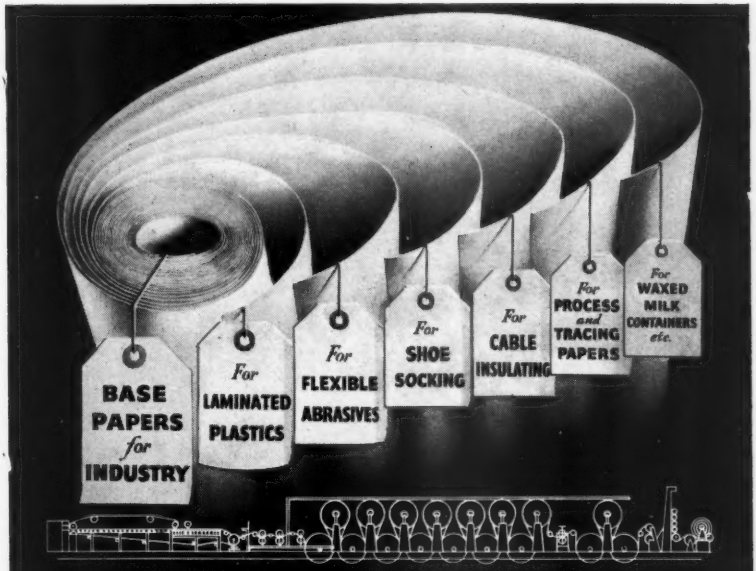

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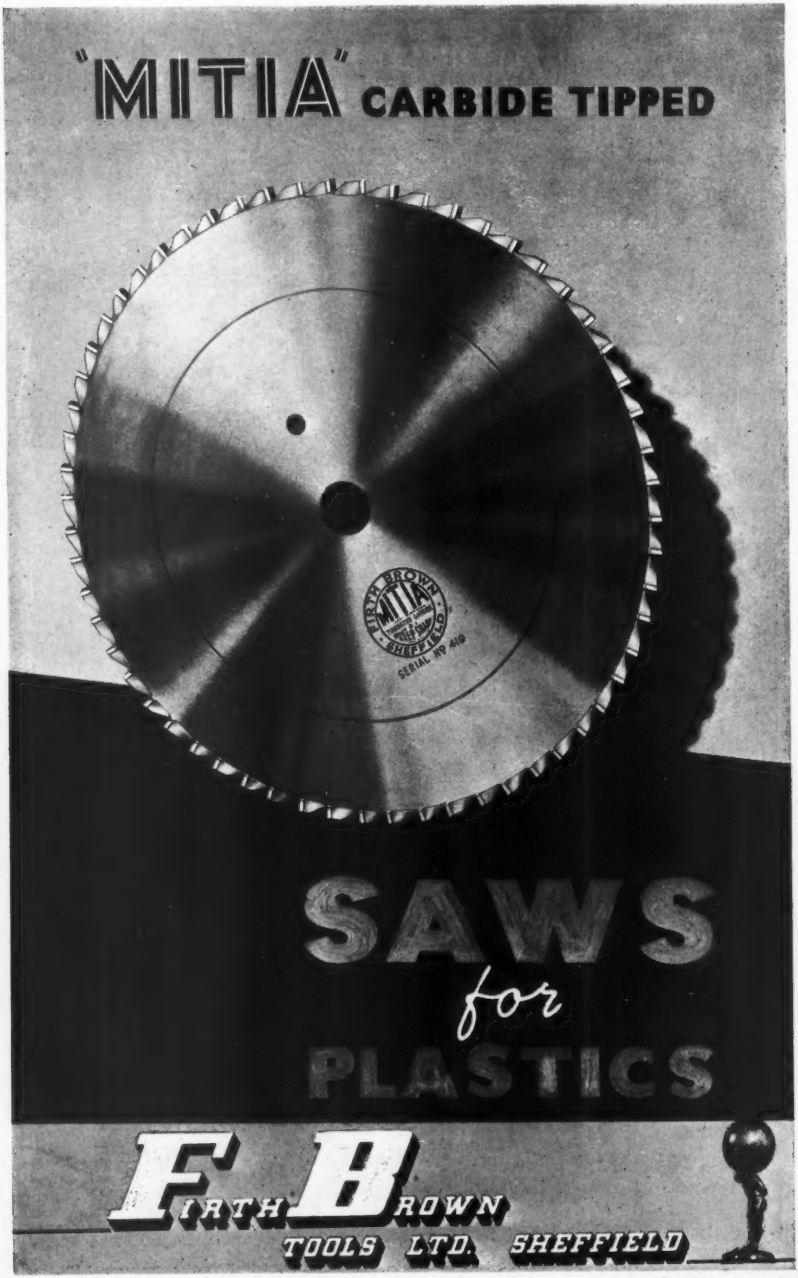
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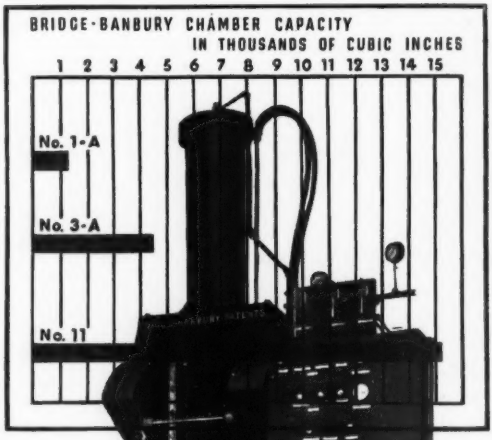

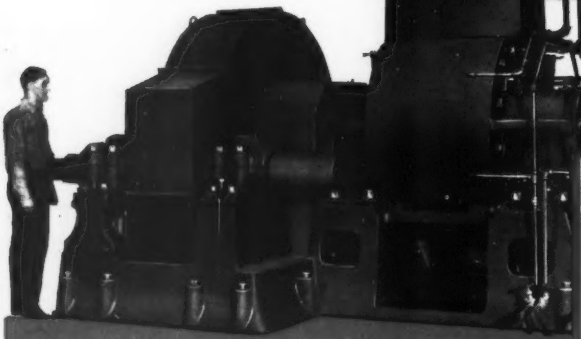

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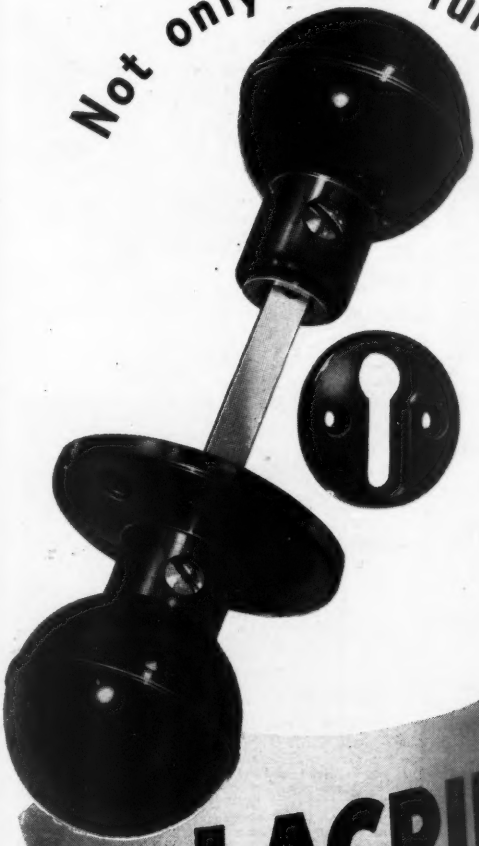

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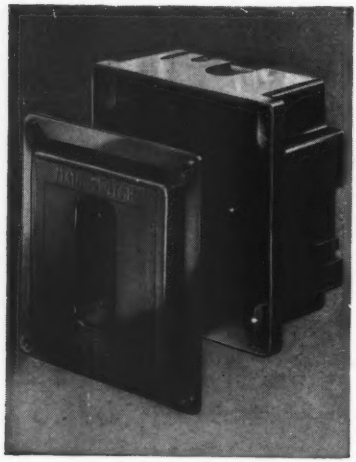

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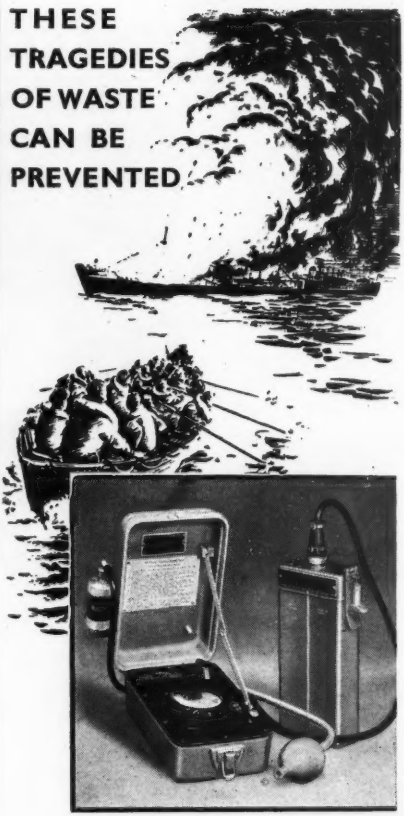

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Southern	Whiteknights, Earley, Reading	Reading 61491
Wales	27, Newport Road, Cardiff	Cardiff 9234
South-Western	12/14, Apsley Road, Clifton, Bristol, 8	Bristol 38223
Midland	Temporary Office Buildings, Hagley Road West, Birmingham, 17	Bearwood 3071
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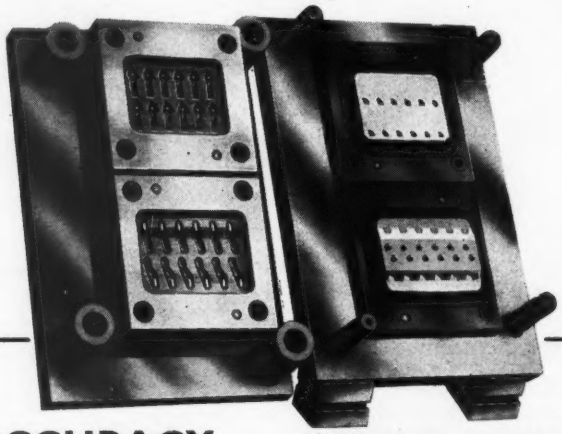

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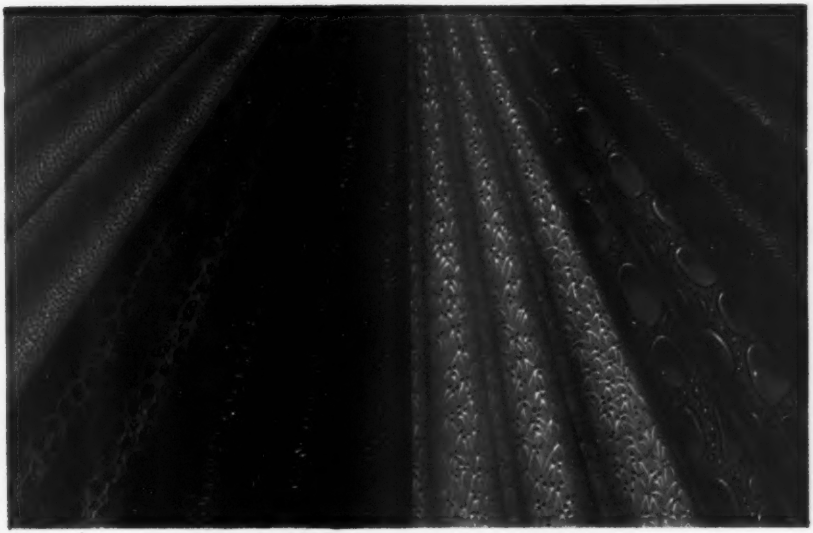

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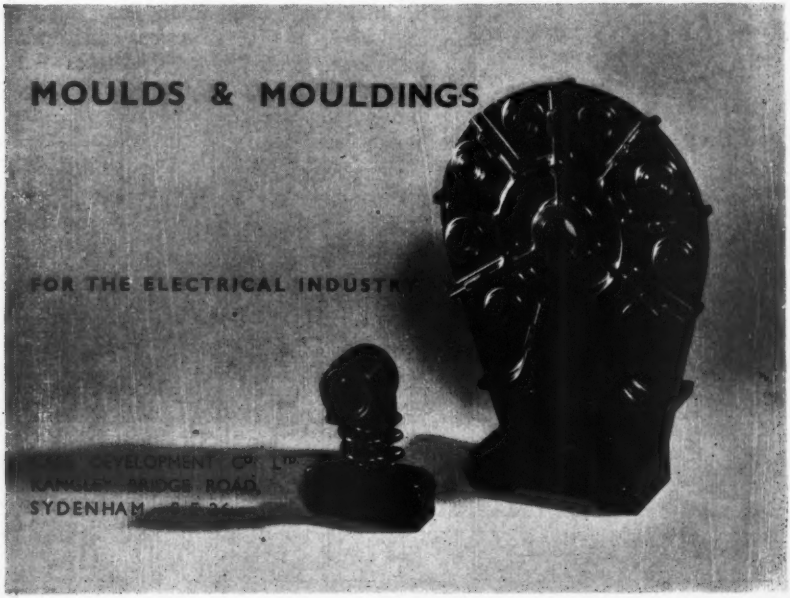

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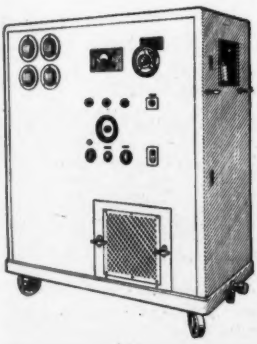

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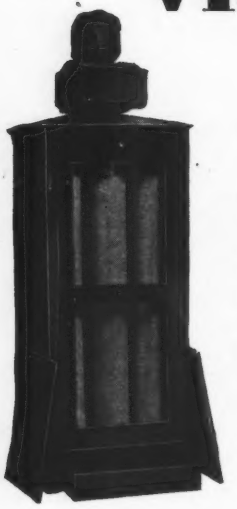

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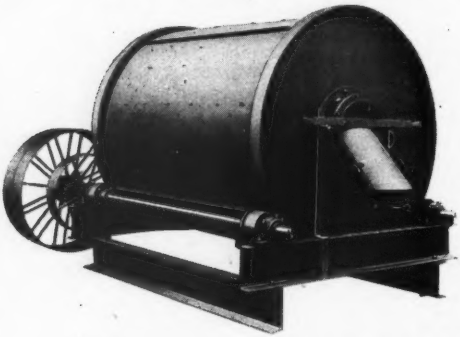

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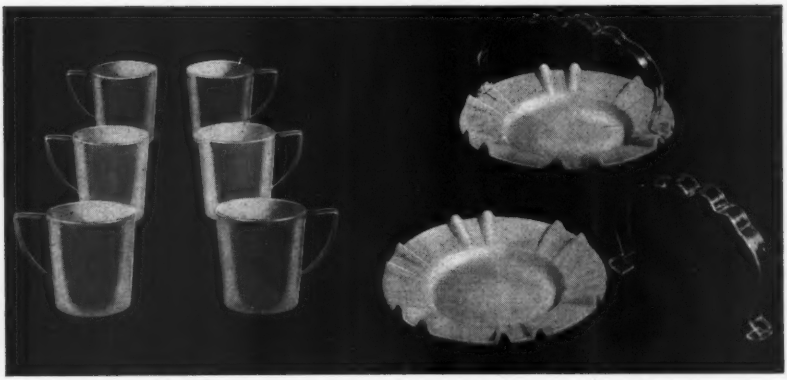

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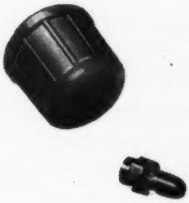

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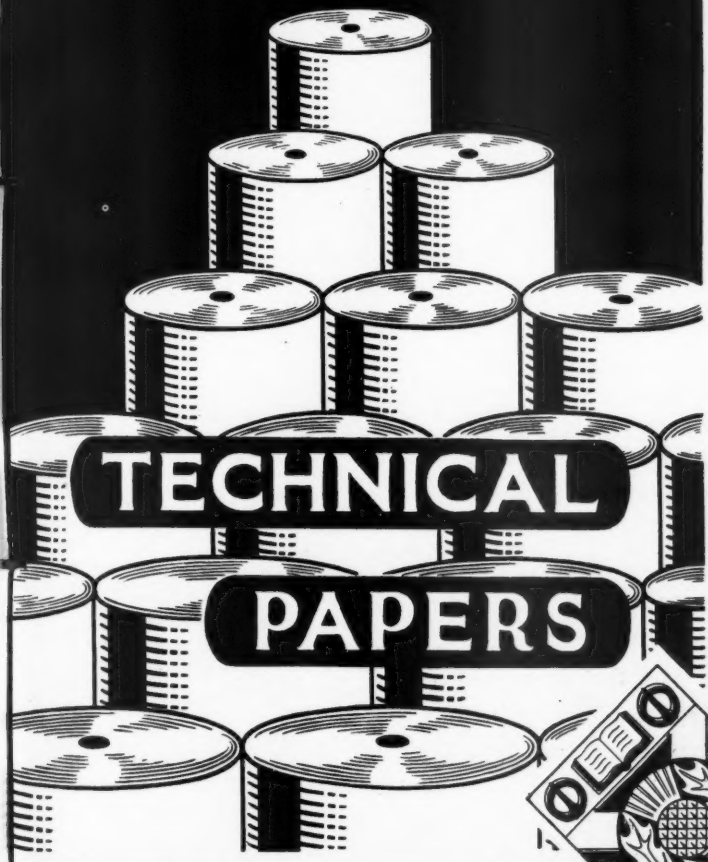

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Vol. XIII. No. 141. FEBRUARY, 1949

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - **TEMPLE PRESS LIMITED**
Chairman and Managing Director **ROLAND E. DANGERFIELD**

Editor - - - **M. D. CURWEN, B.Sc., A.R.I.C.**
Offices - - **Bowling Green Lane, London, E.C.1**

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NOTICES

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EDITORIALS

International Plastics, 1949—Paris

ON Monday, January 24, and during the three subsequent days, there was held in Paris, a great meeting of scientists and technologists from many parts of the world with the common end of discussing scientific, technical and economic problems relating to plastics. It was a most impressive meeting, excellently organized by the Société de Chimie Industrielle and held at the headquarters of the Maison de la Chimie, a magnificent building situated behind the Chambre des Députés.

It was the occasion of the Journées Internationales des Plastiques, the last of which had been held in 1939, the number of visiting members adequately showing how important these "Days on Plastics" are regarded.

Each day included a full conference on a subject of general importance to all scientists and technologists, among the speakers being such famous figures as M. Jacques Duclaux, Member of the Institute of France and Honorary Professor at the College of France on the subject of "The Past, Present and Future of the Chemistry of Large Molecules"; Professor R. H. Houwink, Doyen of the University of Delft, who discussed "Structure and Mechanical Properties of High Polymers"; and M. Leon Jacqué, Maître de Conferences at the Ecole Polytechnique, on "The Development of Plastics in France." These general conferences were inaugurated by the Editor of this journal with a paper entitled "New Sources of Raw Materials for the British Plastics Industry." We take this opportunity of expressing to the Organizing Committee the great honour we felt at being given the opportunity of doing so.

It was a considerable pleasure to all that Great Britain was officially represented by Mr. G. Dring (of Bakelite, Ltd.) for the British Plastics Federation, by F. R. Jones (of J. Lyons and Co., Ltd.) for the Society of Chemical Industry, by Mr. J. L. Megson for the Ministry of Supply, and Mr. J. Taylor for the Plastics Institute.

In addition to these plenary conferences, the main work of the meeting consisted in talks and discussions under five sections: (1) Research, (2) Manufacture of Raw Materials and Testing, (3) Moulding, Mould-making and Fabrication, (4) Application, and (5) Economics of the Industry.

Altogether more than 600 members attended and some 90 scientific papers were read. Of these, four were delivered by British scientists: "The Structure of Phenolic Resins," by N. J. L. Megson; "Properties and Applications of Diallyl Phthalate," by A. Billinghame (of Shell Chemicals, Ltd.); "British Specifications for Plastics, with special reference to B.S.771/1948," by G. Dring; and "The Plastics Institute of Great Britain," by J. Taylor. Mr. Charles Breskin, proprietor of "Modern Plastics," of the U.S.A., delivered two papers, entitled "Industrial Man of 1948" and "The Progress of Plastics Technology in the U.S.A. in 1948." We hope to receive permission to publish extracts of some of the papers in due course.

At the end of each day, films relating to the industry and loaned by American manufacturers were shown, and on January 27 a visit to the Plastics Exhibition at the Pavillon de Marson, in the Louvre building, was attended by large crowds. We shall be referred to this in our next issue.

The reception arrangements were magnificent and in congratulating the Committee and, once again thanking it for inviting us to attend, we hope the next meeting will be attended by many more

British visitors. These occasions are of the first importance to international technology.

Tell the Salesman

READERS will have judged from past issues of this journal and more especially from our editorial in the January issue entitled "Sell—or Go Bust" that we believe "extramural" education should begin by first teaching the buyer and the man or woman behind the counter what plastics are. These many intermediaries, with their everyday contact with the buying world, can act as excellent propagandists for the plastics industry and its products, providing they are given fundamental information regarding the properties and limitations of plastics and from which they can derive a pride in the materials they are selling.

They may gain much by the excellent "national" advertising campaigns now being carried out by a few manufacturers. A new and more direct method is that now evolved by Halex, Ltd., the well-known subsidiary of British Xylonite Co., Ltd., which has just published an interesting little booklet entitled "What's what about Plastics" with the intriguing subtitle "What they are and what they aren't; what they do and what they can't," which is being sent to all agents of Halex, Ltd., here and abroad and to customers sales personnel.

This, in our opinion, is the very book they require as an introduction, to be supplemented by actual experience with our materials with time.

After a simple description of basic points (with technicalities reduced to a minimum) of the various moulding materials and their manufacture, each type is analysed in the form of questions and answers, regarding strength, heat-resistance, cleaning characteristics, wear, etc., and the limitations of the moulded units in respect to them. Each set of questions regarding each type is excellently illustrated by drawings of plastic objects. Some ten different plastics are thus dealt with. This is an excellent propaganda for the whole of the industry and we wish it the success it so obviously deserves.

Design and Colour

THE story told by Mr. George Fejer in the January issue of this journal of the development of his design for a fruit bowl from drawing board to finished moulding has resulted in much enthusiam, as will be seen from some of the letters we publish on another page. What is perhaps equally important is that a number of industrial designers are equally enthusiastic, have cordially welcomed this type of publication and, as a result, have promised, when occasion arises, to contribute in a similar manner. We feel sure that by describing the reasons that lead them to create the designs they themselves have originated, they will clear the air of much misunderstanding.

Likewise, we are sure that there are many technologists in the plastics industry who will echo Mr. Halliday's frank avowal (see p. 88) that. "It comes as a shock to realize that they (the artist-designers) can be as severely practical as we imagine ourselves to be." This is courageous talk; when more engineers and others admit this sort of thing we shall be in sight of that universal collaboration between engineer and designer that is so essential to our industrial well-being.

Mr. Barnes's letter on the subject of colour contains certain truths, but we are not entirely sure that he is not gently (or un-gently) pulling our legs, for obviously furnishings may well contrast amicably with anything from a vividly coloured cup to a golden picture frame. Vividly red cups of china, acrylics or melamine, can be beautiful. A vivid red cup in polythene or other "dull" plastics is, we claim, not beautiful and we believe an analysis of the subject of colour, textures and surface-perfection of plastics and so on would help manufacturers considerably. Possibly the British Colour Council would help.

Book Reviews

"Moulds for Plastics." By W. M. Halliday. Pp. 259 and xvi. Published by English Universities Press, Ltd., London, for Temple Press Ltd. 30s. net.

Mr. W. M. Halliday first began his series of articles on the designing of moulds and their maintenance in "Plastics," in June, 1943, with the war at its height and when the moulding concerns of the country were producing new types of mouldings each in enormous quantities. The extraordinarily practical nature of his articles, both on the design side and on that important task of keeping moulds in efficient operating condition, drew immediate attention and approbation from the plastics and general engineering world. Indeed, they brought into prominence the fact that mould maintenance requires a degree of skill so high, and of detailed organization so complete as to be comparable in effort and intensity with the technique involved in producing *ab initio* the very complicated high-precision tools themselves.

The present book contains much of what was published in "Plastics," but the whole of the series has been entirely re-arranged to make a more unified collection and new material has been introduced.

As a guide to the contents, the eleven chapter headings are as follow: The vital importance of mould maintenance; the permanent record of maintenance activity; mould materials; compression type moulds for thermosetting materials; the semi-positive type of compression mould; injection type moulds; injection moulds for externally threaded components; injection moulds for internally threaded components; safeguarding and fool-proofing mechanism; maintenance factors and equipment for facilitating inspection tests and repairs; treatment of injection mould faults and effective toolroom equipment.

In an era of rapidly advancing technical effort in precision mass production on which this country will depend more and more, this is one of those practical books which we hope will become a standard in the hands of tool makers and tool users in all industries.

"Plastics Technological Dictionary." English-German, German-English. By A. M. Wittfoht. Pp. 316. Carl Hanser Verlag, Munich. 12 DM.

This is the first English-German plastics dictionary we have seen, and an excellent one it is. It is more than welcome, especially since it is exceptionally complete and carefully constructed, and withal illustrated with some excellent diagrams where necessary; for example, in indicating the construction of moulds. A good indication of its soundness is the fact that it is issued by the publishers of "Kunststoffe," the famous German plastics journal.

"Manuel des Plastiques," by Dubois, Cor and Colin. Pp. 387. Presses Documentaires, Paris. 3,000 frs.

We have no hesitation in describing this as a technical guide of exceptional merit.

It is completely different in "texture," for example, from those plastic catalogues which have been published in Great Britain and the United States, which throw their nets so widely and attempt to act as manuals and propaganda devices at one and the same time. In our opinion, this French book, by confining itself solely to the technical problems of our industry, is all that a manual should be. It is, in fact, compiled for the use and guidance of scientists and technologists.

In this sense it is close to the Swiss and German type of production, technical education in these three countries being, in our opinion, of higher standard and much more intense and broader than that of the rest of the world. For this reason the new manual is crammed full of information of technical data that is rarely seen elsewhere.

The whole is divided into four sections:

(Continued on page 112.)

Fig. 1.—General view of works of Thermo-Plastics, Ltd., Dunstable.

Plastics at Dunstable

AT a short distance from Dunstable station the new factory of Thermo-Plastics, Ltd., has now been completed and is in production.

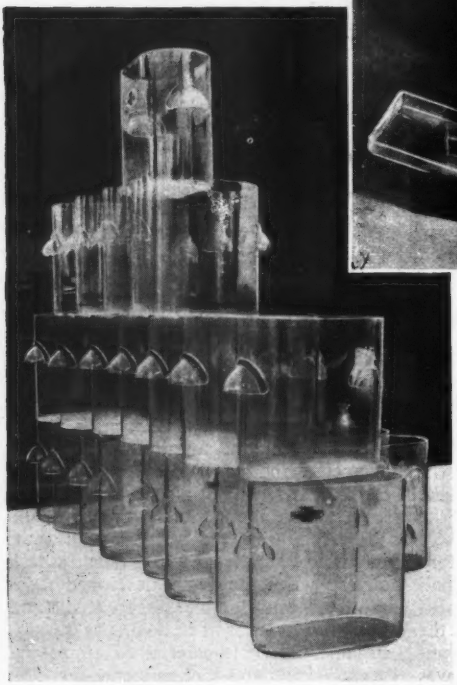
To those who, like us, have followed the fortunes of this company, from its early beginnings in London to the transfer to Dunstable in 1939, and the growth of the several factories there during the war, this modern factory which unites them all, stands as no small monument to the energies of a group of workers headed by Mr. A. Reingand, the managing director, who devoted themselves to a branch of plastics which was originally, and quite generally thought to be, bounded in application by narrow limits. We refer to shaping and fabrication from thermoplastic sheet.

In the early 1930s few looked upon this section of the plastics industry (which had its origins in the late 19th century and now includes the cutting, forming and jointing of cellulose acetate and methyl methacrylate sheet) as of potential value outside that of sign-making, fancy-goods production, or as expensive "glazing" and like products. The policy of Thermo-Plastics, Ltd., however, had long been that of pursuing the study of these materials in a much wider sphere: that of their potential industrial applications. The present factory may be considered the happy result of the success that has been achieved because of this policy.

In the days immediately prior to the war the company had already specialized in acetate and acrylic sheet structures for aircraft, for windows, astro-domes, fairings, ammunition chutes, air-ducts, and so on. During the war this work was intensified greatly and expanded, especially so when the newly developed radar required considerable research into the design of new forms in "Perspex," which became the best material to employ at great heights and low temperatures. This

Fig. 2.—Flexible grid, made in polythene, as used for production of ice cubes in domestic refrigerators.

Fig. 3 (below).—Footbaths for medical treatment when made from acrylic sheet offer a notable saving in weight and also visual advantage.



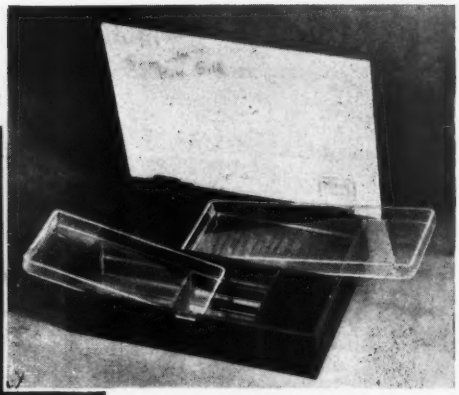


Fig. 4 (above).—This box for displaying haberdashery demonstrates the combined use of "Perspex" and "Bakelite" material.

remains an important branch at these works at Dunstable, where new processes have been developed for forming very large sheets and special installations have been provided for the treatment of complete assemblies to obtain high mechanical strength, freedom from stress, and uniform performance. Here, too, we find the most modern equipment for infra-red heating, ultra-violet and high-frequency polymerizing and welding processes.

To those who remember the small sizes and simple shapes of the early "Perspex" aircraft fitments, certain dome-shaped structures now being produced from acrylic sheet, each some 2 cwt. in weight, are of such size and complicated curvature that the technique of the 1930s fades into insignificance.

It was also during the war that the post-forming process applied to phenolic laminated sheet received its real industrial baptism. At the works of Thermo-Plastics, Ltd., where jig-construction had reached a high level, the properties of resin-impregnated fabric and its forming possibilities and limitations had also been closely studied. This new raw material for shaping was soon regarded as one of the most promising for structures requiring especially high strength, and immediately found an outlet for the production of pilots' seats, chutes, and other special shapes.

With such experience there was little difficulty in passing over to the manufacture of peace-time goods, since the main trend has been the production of industrial units. Aircraft structures still remain, as we have observed, an important item in the manufacturing programme of the company, but it is interesting to note that industrial produc-

Fig. 5.—View of part of the moulding shop at the Dunstable works of Thermo-Plastics, Ltd.

Fig. 6.—The air-blowing technique in practice: removing a "Perspex" wash-basin from the press.

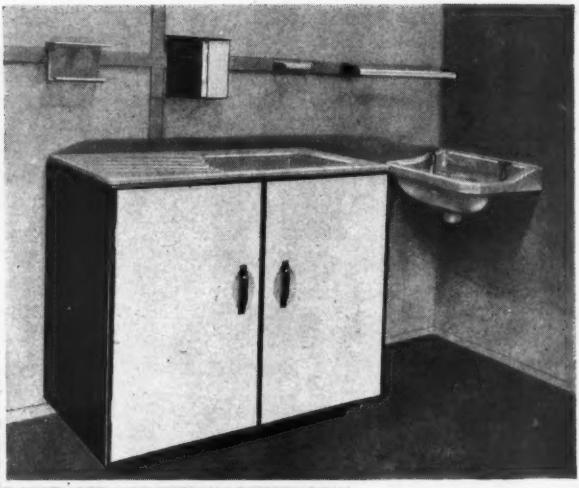


Fig. 7 (right).—Combined sink and draining board, wash-basin and bathroom fittings in acrylic material of contrasting shades.

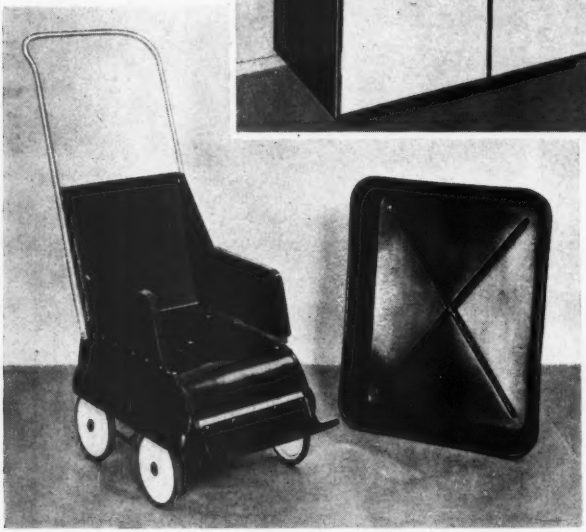


Fig. 8 (left). — The general utility of wire-reinforced cellulose acetate material is seen in this child's push-chair and the large photographic developing tray.

tion appears to have moved in well-defined lines.

One of the most interesting developments is in the field of refrigeration. Here, quite apart from the remarkable constructions of "ghost" refrigerators which this company has built for refrigerator manufacturers to be used as demonstration units, plastics are widely employed in the working units themselves, more especially as large and small dishes. "Perspex" is an excellent material for many refrigeration units, and so, too, is polythene. An interesting application of the latter, now made at Dunstable, is the flexible grid (Fig. 2) as used for producing ice cubes. Polythene, which is so easily cleaned and so highly resistant to water, is admirably suitable for this purpose. Such objects are produced upon an injection machine, a battery of which has recently been installed.

Of even greater interest is the employment of formed acrylic sheet for equipment needed by the new "deep-freeze" vegetable and fruit storage industry.

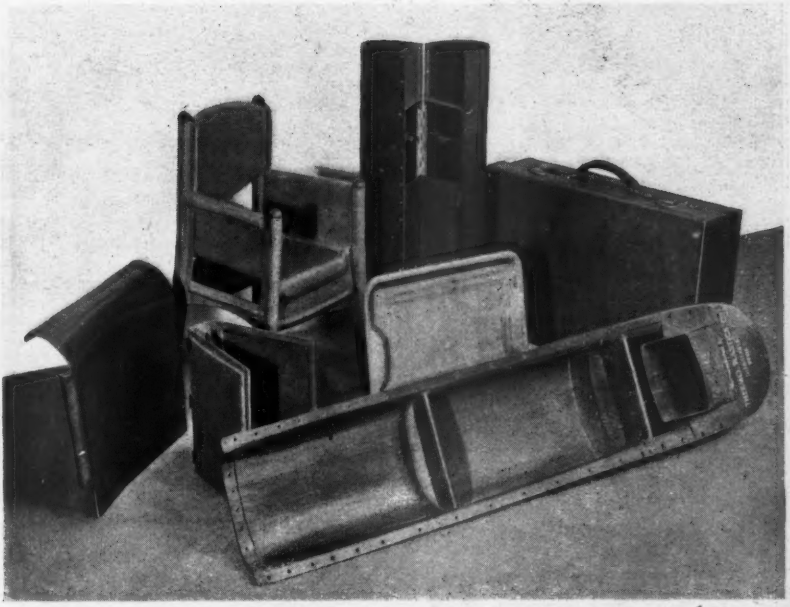


Fig. 9.—Aircraft components (air chute, in foreground), industrial components (water tester case, at rear), and consumer goods (child's chair, suitcase, ledger cover, etc.) as produced by post-forming laminated material.

Fig. 10.—Two of the largest pressings yet made from acrylic sheet by the air-blowing technique: the surround for a "deep freeze" foodstuffs display cabinet and the container, capacity 9 cubic feet.

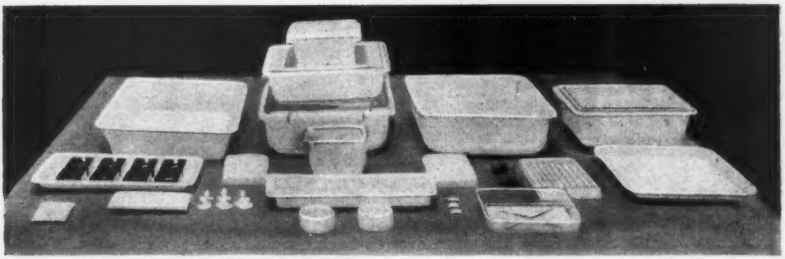


Fig. 11.—Representative collection of the smaller refrigerator components as produced in "Perspex," polythene, polystyrene, phenolic and urea.

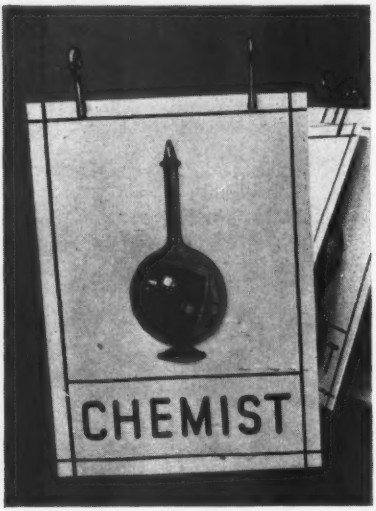


Fig. 12.—A novel effect is obtained by the combined use of opaque white and transparent coloured acrylics in this swinging sign for a chemist's shop.

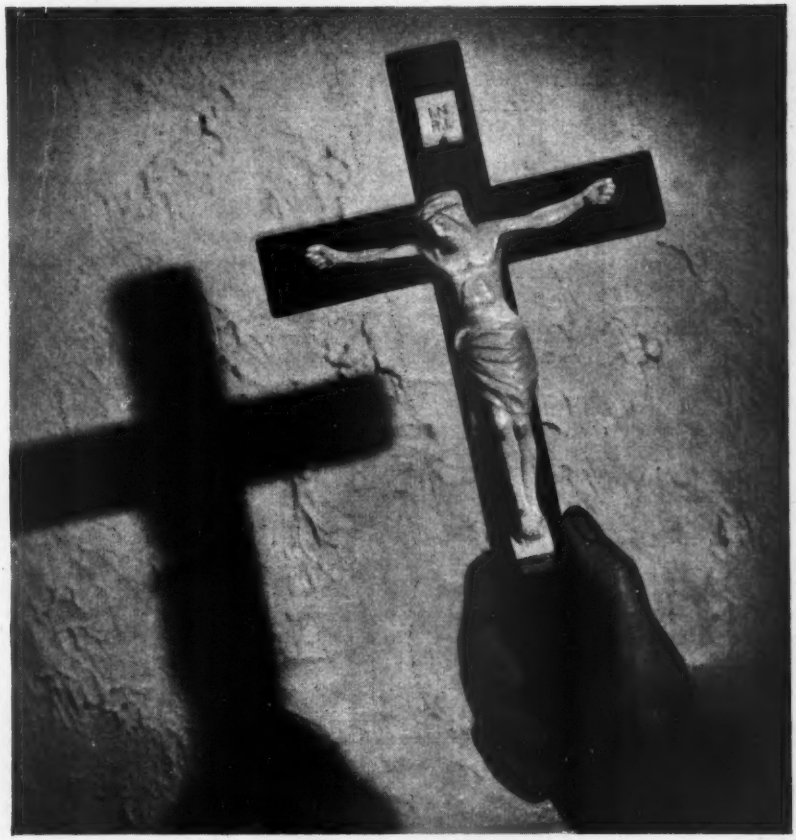
Fig. 10 shows what are probably two of the largest tanks or containers ever pressed. The air-blowing technique is employed in most of the large jobs. Its use is also seen in practice in Fig 6, which shows the production of "Perspex" washbasins, one of a number of articles made especially for the sanitary ware trade. Manufactures for the latter include also sinks, lavatory seats and other bathroom units of the same material.

In other fields, the forming of sheets is widely employed for the production of radio cabinets, television units, medical baths and clock cases.

In the field of post-forming laminated fabrics, much success in peace-time application has been achieved (Fig. 9). We have already noted in previous issues of this journal the manufacture of aircraft chutes, a structure for holding water-testing apparatus, and a suitcase of great strength and lightness which has particular value for air travel. The texture of the laminated fabric imparts an appearance of exceptional beauty to this suitcase. Here at these new works we have recently seen other industrial applications, such as large photographic developing trays and tanks, where strength and more especially good resistance to chemicals are required.

As an expansion and corollary to all this work, there has grown up a section for moulding both thermoplastics and thermosetting moulding powders, and a highly efficient tool room where all the needed moulds, jigs and fixtures are produced, these greatly assisting the production of units for industrial and scientific use which involve high precision work, mainly for the heavy electrical, wireless, engineering and other industries.

TENAPLAS, LTD., announce the removal of their sales department from Upper Basildon, Pangbourne, Berks, to 78, Buckingham Gate, London, S.W.1 (Telephone: Whitehall 8735).



RELIGIOUS ART IN PLASTICS

This crucifix is a good example of British craftsmanship in tool-making and moulding. The black phenolic cross measures 10 ins. × 6 ins. It is produced from a vertical flash compression tool and has three holes moulded in the front face for accommodation of the sprue stalks of the Corpus and inscription plaque, both of which are made by the transfer moulding method.

The Corpus is moulded of ivory urea in a transfer tool of intricate form and somewhat unusual size, but the irregular cut-off contours are matched to give a paper thin flash. This, combined with the high finish of the tool, necessitates hardly any finishing of the moulding. The tool is provided with a two-stage stripper and rate of production is higher than might be expected. The inscription plaque is moulded in a multi-impression vertical flash transfer tool.

After the urea mouldings are finished, the sprue stalks are inserted in the holes in the cross and cemented. When set, the surplus lengths of stalk protruding from the channelled back of the cross are cut off flush with the surface.

Moulds and mouldings are a product of Case Development Co., Ltd., Kangley Bridge Road, Lower Sydenham, London, S.E.26.

World's Industry Employs Plastics

GENERAL ENGINEERING

Design of components.—C. O. Grimm, in a lecture at the Swiss Plastic Conference, dealt with the problem of designing components from the point of view of various materials and moulding conditions. He discussed many practical applications and difficulties encountered in practice. ("Schweizer Archiv fur angew. Wiss. und Technik.," 1948/Nov./344.)

Bonding of silicon steel.—S. B. Ashkinazy and J. J. Preisler describe the problems encountered in the development of a satisfactory method for bonding silicon-steel laminations in electrical cores, using a thermoplastic resin adhesive. Electrical considerations underlying magnetic core design are reviewed. ("Product Engineering," 1948/Nov./85.)

Adhesion. — A study of adhesion requires knowledge of character of bond between adhesive and surface, nature of film, and of surfaces permitting adhesion. Electrical forces resulting from the dipole movements of polymer polar substituents and ordinary dispersion of forces have been used to explain the strength of adhesive bonds. (A.S.T.M. Bulletin, 1948/Dec./50.)

Thermosetting laminates.—N. A. Skow describes basic grades of thermosetting laminates, standardized by fabrication, composition and properties. ("Product Engineering," 1948/Dec./123.)

Wood-waste materials.—In his review on plastics in engineering, W. Nichols refers to the utilization of sawdust, straw, and other wood waste. He describes the composition, production, and application of the materials known as "Plumberwood" and "Delaforce." ("Machinery Lloyd," 1948/Nov. 17/80.)

Sawing plastics.—R. Liebtanz discusses the requirements and technical features of machines for sawing plastics. ("Kunststoffe," 1948/Nov./226.)

Fully automatic moulding.—W. Heprath discusses the development work for fully automatic moulding of thermosetting resins. The problem as yet has only advanced to the semi-automatic stage. The author refers to work by Schmidberger (Vienna), International Galalith Ges., Roemmler A.G., and Siemens-Schuckert Werke, and to the patents granted in this field. ("Kunststoffe," 1948/Nov./227.)

ELECTRICAL

Wire and cable insulation. — A colloidal dispersion of modified vinyl resins in water containing 55 per cent. total solids (Geon Latex 31X) is useful for protecting fibrous braid; it is easy to process and has a wide colour range. Another material (Geon Polyblend) is a colloidal blend of polyvinyl chloride and Hycar nitrile rubber, having unique jacket and low voltage primary insulation applications. It can be compounded (1) as a thermoplastic similar to vinyl; (2) to permit vulcanization; (3) to modify either polyvinyl chloride or nitrile rubber compounds. ("Wire and Wire Products," 1948/Oct./931.)

Arc-resisting plastics. — The quick-setting, new thermosetting moulding compound, "Plaskon Alkyd" (Plaskon

Division, Libbey-Owens-Ford Glass Co.), is successfully applied for electrical switch units and connectors where arcs are anticipated. Arc resistance of parts is 190 to 200 secs. under standard A.S.T.M. test procedure. A phenolic general-purpose part failed at 10 secs.; phenolic-electric after 20 secs.; melamine, general after 120 secs.; electrical in 132 secs. The new compound did not show any failure after 165 secs. ("Product Engineering," 1948/Nov./133.)

Dielectric investigations.—Since in recent years the frequency range in which insulating materials are used has been considerably extended, a new method for determining dielectric constant and the dielectric loss is suggested by E. Alpers and T. Gast. In this test a 5 to 7 mm. ball of the plastic to be investigated is suspended on torsion balance in an electrostatic field of varying frequency and variable temperature. The first measurements with this new method are given for phenolic resins and polyvinyl chloride. ("Kunststoffe," 1948/Nov./230.)

CHEMICAL

Volatility of plasticizers.—H. Hofmeyer deals with the testing of volatility applied to the plasticizer itself and also the finished products. He describes apparatus for taking volatility curves; the result of some investigations are discussed ("Kunststoffe," 1948/Nov./235.)

Thermal decomposition of polymers.—Leo A. Wall describes the application of the mass spectrometer to the study of thermal decomposition of polymers and discusses the relationship between the structure of polymers and yield of monomers on decomposition. ("J. Research Nat. Bur. Standards," -948/41/315.)

Condensation of phenolic resins.—In the production of the thermosetting phenol-formaldehyde resins, the German industry is using cresols and xylenols to an increasing extent in place of phenols, which are said to change the properties of the resins in several respects. H. F. Mueller and I. Mueller have investigated these resins by acid filtration methods, and the results are being used to elucidate the processes during condensation and curing. ("Kunststoffe," 1948/Nov./221.)

High-temperature thermoplastic.—A new polymer of trifluorochlor-ethylene (M. W. Kellogg Co., 223, Broadway, New York, 7) containing three-fifths by weight of fluorine and chlorine, is colourless, transparent and flexible, but can also be blended with fillers or laminated with wire or glass cloth. It differs from the fluoro-carbons, as some fluorine is replaced by chlorine. Tests showed that it will stand up over a temperature range of 700 degrees F., i.e., from −320 to +390 degrees. The material deforms slightly under pressure, but snaps back when pressure is removed. It has further high-impact strength at low temperatures. ("Business Week," 1948/Sept. 11/74.)

MISCELLANEOUS

Laminated paper.—A short article deals with the manufacture, properties and the machining (turning, drilling, milling, sawing, grinding, etc.) of laminated paper. ("Techn. Rundschau" (Berne), 1948/Nov. 20/4.)

Plastics in Russia.—The mechanical properties of vulcanized butadiene styrole rubber under two dimensional deformation (G. M. Bartenev, B. A. Dogadkin and N. M. Novikova), and the optical properties of polarizing light filters of polyvinyl alcohol (D. A. Todina), are the subject of two researches recently published in "J. Tech. Physics," 1948/18/1282, 1317.

Plastics Production and Consumption

Source : Central Statistical Office, "Annual Abstract of Statistics, No. 85, 1937-1947." (H.M. Stationery Office, 1948.)

	1941	1942	1943	1944	1945	1946	1947
	tons	tons	tons	tons	tons	tons	tons
Total synthetic resins							
Production	16,096	20,931	23,979	24,424	25,424	35,069	41,027
Total disposals	15,766	20,291	24,069	24,551	25,696	35,122	41,328
Home consumption	15,560	20,202	24,005	24,502	25,186	31,882	37,280
Phenolic:							
Production	—	—	8,937	9,644	10,058	12,959	10,970
Total disposals	—	—	9,033	9,640	10,279	13,134	11,470
Home consumption	—	—	9,016	9,636	10,064	12,309	11,111
Cresylic:							
Production	—	—	8,723	8,293	6,996	9,280	11,727
Total disposals	—	—	8,737	8,465	7,114	9,281	11,695
Home consumption	—	—	8,695	8,436	6,964	8,768	11,115
Urea:							
Production	—	—	5,924	5,905	7,902	11,744	15,487
Total disposals	—	—	5,898	5,905	7,823	11,646	15,426
Home consumption	—	—	5,894	5,890	7,701	9,833	12,528
Other synthetic resins:							
Production	—	—	395	582	468	1,086	2,843
Moulding Powders							
Phenolic and cresylic:							
Production	13,521	13,124	14,289	15,249	17,531	25,221	24,723
Total disposals	12,593	13,100	14,195	15,330	17,487	25,413	29,743
Home consumption	11,117	11,952	13,679	14,742	15,814	22,332	26,709
Urea:							
Production	4,136	4,080	3,869	2,760	3,996	6,471	7,941
Total disposals	4,039	4,046	3,948	2,824	4,067	6,434	8,635
Home consumption	2,456	3,243	3,447	2,396	3,115	5,132	7,248
Cellulose acetate:							
Production	1,207	1,343	1,489	1,307	2,162	4,294	3,730
Total disposals	1,204	1,335	1,344	1,324	1,967	4,425	3,521
Home consumption	1,063	1,279	1,326	1,262	1,784	3,587	2,863
Cellulose acetate sheet, rods, tubes and film							
Production	2,335	2,718	3,059	2,623	1,133	1,443	1,310
Total disposals	2,255	2,772	2,941	2,573	1,279	1,438	1,291
Home consumption	1,938	2,041	2,928	2,571	1,215	1,348	1,195
Perspex							
Production	1,463	2,507	3,796	4,718	1,832	3,949	4,361
Total disposals	1,182	2,594	3,629	4,370	1,851	4,024	4,435
Home consumption	1,011	1,102	2,764	3,407	1,798	3,568	3,484
Celluloid							
Production	1,719	1,531	1,486	1,572	1,976	2,100	2,091
Total disposals	1,723	1,651	1,544	1,450	1,857	2,194	2,247
Home consumption	1,019	1,518	1,501	1,331	1,391	1,856	2,071
Polyvinyl chloride (unplasticized)							
Production	—	—	745	3,365	4,122	5,471	6,467
Consumption	—	—	3,875	5,892	5,122	7,932	7,941
Polyvinyl chloride (plasticized)							
Production	—	—	—	10,082	8,463	10,774	11,278
Consumption	—	—	—	10,025	8,736	10,280	10,890
Casein plastic materials							
Production	1,480	1,724	1,523	1,433	2 051	2,002	2,528
Total disposals	2,018	1,851	1,566	1,443	1,899	2,140	2,361
Home consumption	1,801	1,735	1,530	1,370	1,421	1,413	2,156
Laminated materials							
Production	—	—	7,672	8,474	5,929	6,321	6,562
Consumption	—	—	7,422	8,446	5,895	6,412	6,538

Fig. 1.—General view of assembly hangar.

Body-building for Motorcars

We are indebted to the Technical Service Department of Aero Research Ltd., Duxford, Cambridge, for the following details of the use of their synthetic resin glue in Healey and Alvis motorcar body-building by Duncan Industries (Engineers) Ltd., recently the subject of Aero Research Technical Notes, Bulletin No. 71.

BODY-BUILDING for high-class luxury and sports cars has succeeded the craft of coachbuilding for horseless carriages and earlier conveyances. Wood, nevertheless, remains the basic material for this industry, in which there is exceptional scope for individual craftsmanship and design.

Duncan Industries (Engineers), Ltd., of Swannington Aerodrome, Haveringland, Norwich, use synthetic resin glues for their assembly gluing. There are no metal pressings in the Duncan bodies, but the wooden structure is reinforced by metal stiffeners at four points where the load is exceptionally heavy. Otherwise, the frames are assembled, using screws and "Aerolite" 300F with hardener GBP.X; a durable glue line keeps the structure rigid and screws which may

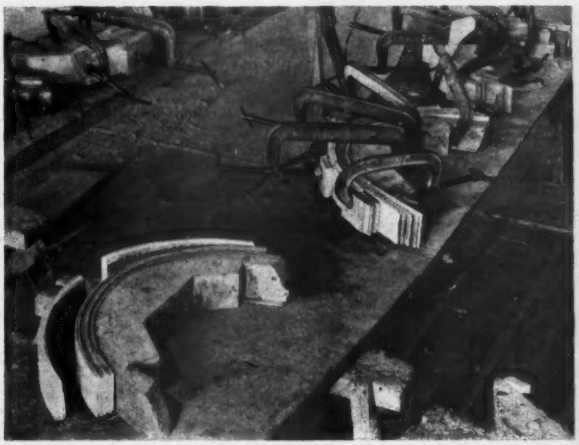


Fig. 2.—Laminated bends for wheel arches are constructed at normal shop temperature using synthetic resin glue.

Fig. 3.—A typical joint incorporating screws and glue: the front screen top rail and cart rail assembly.

become rusted are not pulled through or broken.

Several of the jigs used in the assembly of the bodies are themselves of glued and screwed construction. Jigs for making laminated bends for front and rear wheel arches are seen in Fig. 2. These jigs are of robust design, utilizing screws and glue throughout. Nine laminations comprise each arch; they are coated on one side with "Aerolite" 300F and on the other with hardener GBP.X, and are then clamped as shown at ordinary room temperatures to the shape of the jigs. Pressure is maintained by hand clamps for about six hours at 50 degrees F., or three hours at 60 degrees F., which are the normal times required for the glue to set.

Laminations of this kind possess far greater strength than solid bends and lend themselves more readily to forming operations which do not need the application of steam. The principle is emphasized in the design of the rear light frame, which is again of extremely interesting laminated construction (Fig. 4).

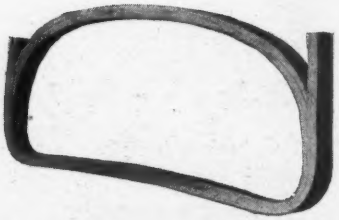


Fig. 4.—The rear light frame, a laminated structure, makes full use of the strength and durability of synthetic resin glue.

Fig. 5.—Rear roof and waist rail joint.

Fig. 6 shows the principal components of the Healey coachwork assembly. Most of the work for each body is carried out on jigs in an extremely large hangar (Fig. 1), but some of the smaller units are first assembled on the bench. The bottom side (I) and sill (H), for example, are glued and screwed together on the bench, then transferred to one of the

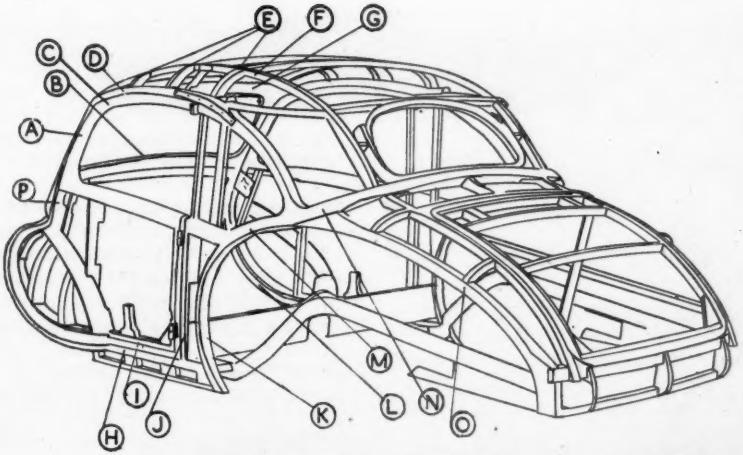


Fig. 6 (above).—Principal components of the Healey coachwork assembly.

Fig. 7 (right).—The complete Healey-Duncan, as shown at the Paris Exhibition.

main jigs in the hangar. The screen sub-assembly consisting of the two side pillars (A), the top rail (G), and bottom rail (B), are likewise assembled on the bench before being placed on the main jig. Next, the bottom screen pillars (P), followed by the rear standing pillars (J), are fitted on the jig.

The quarter-rail sub-assembly (N) is glued and screwed together on the bench, then (on the jig) attached by a half-lap joint to the rear standing pillars. The cant rails (D), the roof sticks (E), and roof runner rails, are also assembled on the jig; Fig. 3 gives a good idea of the strength and rigidity of the joint between two of these members and the screen sub-assembly.

The bonding of the rear ends of a roof runner rail and cant rail is seen in the view of the rear roof and waist rail joints (Fig. 5); on the left of this photograph appears a section of the laminated rear light frame which is fitted later. The wheel arch top pieces are next glued and screwed to the waist rail, followed by the various components of the boot—the boot bottom rail, boot lid short rails, boot lid standing rails and boot hinge rail. The back light lamination is added after the back light trim rail and quarter trim rails, and finally the front wheel arch rockers and door rockers are incorporated.

When the main body assembly is complete it is taken from the jig and trans-

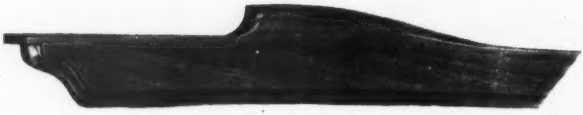


Fig. 9.—This attractive window light moulding consists of four laminations.

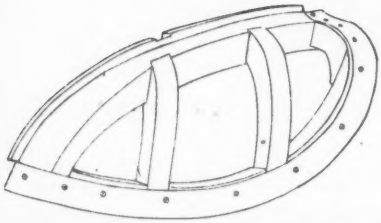


Fig. 8.—The door blisters are formed with the aid of this special jig.

ferred to a trestle, where the doors and boot-lid are fitted. The structure is now ready for the metal bodywork to be dropped into position, covering the wooden members like a skin or shell.

Two other instances of glued construction are of special interest: the jig (Fig. 8) is used for forming the door blisters. It is screwed on to the door when the light-alloy body is fitted and two metal panels are formed over it; after these have been welded together the jig is removed. As may be seen, the wooden members of the jig are glued, while a metal strip is screwed round the lower edge.

Fig. 9 gives an impression of the pleasing appearance of the windowlight moulding which is screwed to the door from the inside after the upholstery has been fitted; this section consists of four laminations glued together.

"Aerolite" 300F, which is used throughout in the construction of Duncan bodies, is a urea-formaldehyde resin—a slightly more viscous form than "Aerolite" 300. Hardener GBP.X is a colourless hardener of medium speed of setting. The combination of glue and hardener provides joints which are fully resistant to water and are unaffected by the attacks of mould, fungi, etc., associated with moist conditions. These properties are clearly of the utmost importance when glues are used in the construction of products for export, often to tropical and sub-tropical territories.

A further advantage of "Aerolite" 300F and hardener GBP.X is that they provide a gap-filling glue-line which does not deteriorate with age. The resin is applied to one of the surfaces to be glued and the hardener to the other surface. The joint is then lightly clamped and left to set at normal room temperature; only sufficient pressure to retain the surfaces in contact is required, but heat may be applied, if desired, to accelerate the setting process. No mechanical fillers are incorporated to impart gap-filling properties to the glue-line, and the joint is therefore immune from any tendency to craze and lose strength.

Soft Abrasive Blast Cleaning for Moulds

Soft grit, consisting of pellets of groundnut shells and fruit pips, which have been specially treated to produce a finely graded powder of even particle size, is being employed in the United States for speedy and thorough cleaning—on the "sand-blasting" principle—of moulds used in the rubber industry. The use of this material, supplied under the trade name "Shell-Blast," has been demonstrated jointly by the Vacu-Blast Co., of San Matio, and Agicide Laboratories, of Los Angeles. Special plant has been developed by the Vacu-Blast Co. for the cleaning of tyre moulds. The process is claimed to be revolutionary, as moulds may be cleaned without need of removing them from the presses. The pellets, which are almost pure ligno-cellulose, are not abrasive, and in the case of steel or plated steel the actual surface of the mould suffers no damage. As a further advantage, this soft abrasive is found to leave a thin protective film of natural wax on the mould surface after cleaning has been completed.—("India Rubber Journal," 1948/Aug. 7/14.)

Utilization of Polyvinyl Chloride in the Manufacture of Shoes*

By Dr. Heinrich Berger

Translated by

Paul Grodzinski

THE supplying of the population of a country with satisfactory shoe wear is a most important problem. Some data from the Statistical Year Book of the German Reich from 1938 may be of interest. According to this source, about 30 million pairs of men's shoes, 31 million pairs of women's shoes, and 5 million pairs of children's shoes were produced, apart from 25 million pairs of footwear not specifically stated to belong to one or other of these groups and being of somewhat inferior type. According to the same year book, about 55,000 tons of sole leather was utilized in Germany in 1938. If one compares these figures with those for the production of natural leather, it is evident that it became necessary to look for suitable substitute materials ("Ausweichstoffe") for the shoe industry. The first idea for satisfying this tremendous demand was to use the Buna synthetic rubber for the production of soles.

In contrast to former attempts to provide street shoes with crepe-rubber soles, the rubber industry tried to bring a sole of a leather-hard material upon the market. This sole corresponded in life and hardness to the requirements of the shoe industry but, naturally, this material had not the same permeability for water vapour as was evident for good sole leather, although it showed a considerably higher life. Where one could assume for good sole leather a life of 500 miles, good Buna soles had a life of 1,250 to 1,500 miles. Different opinions, however, existed about the most suitable composition of the Buna sole. The first attempts in this direction were a failure; on account of the scarcity of raw materials, the Buna content was too low.

Compared with the Buna sole, the usual mixtures of polyvinyl chloride (Igelit-PCU) and plasticizers have the natural disadvantage of a considerably lower life, and extended investigations became necessary to find suitable mixtures. Ultimately, using suitable plasticizers and fillers, a sole was developed which responded to all requirements and was accepted and introduced as "P-sole." The life of such a sole, of suitable construction, is about 1,250 miles. It should be mentioned, however, that the P-sole has a percentage of synthetic materials considerably higher than the Buna sole.

A further point against the introduction of the P-sole is the high notch sensitivity of the plasticized polyvinyl chloride, as well as the necessity to find a suitable cement for fixing the sole to the shoe. Further, the cold-brittleness of the material had to be considered when developing the mixture.

Composition and Properties of P.V.C. Soles

In the first test for the production of a polyvinyl chloride sole a mixture without filler, consisting of about 50 to 60 per cent. Igelit-PCU and 50 to 40 per cent. plasticizer, was used. Since mixtures with tricresyl phosphate become considerably brittle at temperatures above 0 degree C., the tricresyl phosphate was replaced by other plasticizers, among which Palatinoles and mixtures of Palatinoles with tricresyl phosphate, and Mesamoll, were found very suitable. As already mentioned, such mixtures, in particular when their strength at low temperatures is important, do lead to relatively soft material. Efforts were therefore made to obtain greater life by

* A communication of the Plastics Raw Material Laboratory, Badische Anilin and Soda Fabrik, Ludwigshafen a. Rh., published in "Kunststoffe." 1948, 38, 135

using fillers. Admixtures of fibrous material, for instance, cork flour, being of advantage theoretically, could not be used as the necessary quantities were not available; further, the advantages of these fillers were not as great as had been expected. Ultimately, mixtures were used with 50 per cent. polyvinyl chloride and 35-40 per cent. plasticizer, the balance being filler. A plate of this material has a tensile strength of about 2,130 lb. per sq. in., an elongation of about 200 per cent., and ability to withstand low temperatures between −15 and −20 degrees C.

More important than the resistance to low temperature measured in the laboratory, is the practically determined low temperature strength of the complete shoe. It was found that such shoes meet all demands of a hard winter, under the assumption that the attachment to the already worn shoe is satisfactory in every respect, and that holes in the shoe are carefully repaired.

Laboratory tests did not prove to be sufficient to give rigid judgment on the practical performance of the new material. The authorities concerned, as well as Carl Freudenberg, Weinheim, at Bergstrasse, therefore established test runways on which the soles were tested under practical conditions. These runways included sections of concrete road, slag paths, sand pits, splinter-stone paths, coarse gravel, and paved roads. As it was not possible to wait until the soles were completely worn a so-called point value was introduced, which indicated when the point of the sole was worn. The total life was then estimated to be about 2 to 2½ times the point value.

The P-soles based on the above mixtures have proved themselves very well in practice and are able to give the German population a shoe wear of full quality. The lacking permeability to water vapour did not lead to any serious criticism; which is understandable, as even a leather sole, after a short period of wear, becomes clogged with dirt from the road, oil, etc., so that the permeability factor is very much below its initial value. Quite recently, however, the manufacture of the P-sole had to be reduced, because production of polyvinyl chloride itself had been reduced considerably. Therefore, this high quality material can now be used only in such places where it cannot be replaced by other substances.

Polyvinyl Chloride for Shoe Uppers

Apart from its use for soles, polyvinyl chloride (Igelit) has been used as a substitute for shoe uppers. It was quite obvious to use the so-called artificial leathers as a substitute material for this purpose. Applied in this manner were textiles provided with a plasticized Igelit film. The use of such products was recommended owing to their excellent rubbing strength, resistance against ageing and resistance against breaking. It did not matter whether the film is supplied by calendering or by means of so-called Igelit-pastes, for in each case the leather substitutes obtained showed excellent wear properties.

Shoes were also produced from an unbacked or self-supporting plastic foil, i.e., without textile basis. These, however, did not prove very satisfactory, because the high notch sensitivity of the polyvinyl chloride and difficulties in attachment to the sole of the shoe led to complaints. Instead of the foil, plasticized polyvinyl chloride bands were used quite recently to an increased extent for so-called summer shoes. These bands are easily produced by machines, since rolling mills and calenders are not necessary, and, indeed, under present conditions in Germany, are difficult to obtain. Simple injection machines as are used for the covering of wires in the electrical industry, with suitable nozzles and some alterations, permit the production of very durable bands and belts which are not easily breakable, and these highly coloured materials are very much liked.

In this case, the attachment of the uppers to the sole portion is difficult. Cementing alone is not sufficient, and more secure attachment by nails or sewing becomes necessary. This, again, increases

the notch sensitivity of the material, and leads to many repairs. If a sewing seam starts near the edge, the band has a tendency to break, but by suitable design or use of a special shape it may be possible to largely mitigate these deficiencies.

Shoewear Produced by Injection or Dipping Processes

It is possible to use plasticized polyvinyl chloride (Igelit) for injection moulding, similar to the production components made of polystyrene or cellulose acetate. The attempt to produce the whole shoe in "one cast" is therefore understandable, simplifications in shape possibly being required. For a certain type of shoe, such as sandals, this method may have a future.

In this connection the manufacture of shoes from Igelit pastes by the dipping process should also be mentioned. For instance, galoshes, similar to rubber galoshes, could be produced by this method, using plasticized polyvinyl chloride. Further, larger products, such as shoes for workers in mines and sewers (watershoes) could be produced in this way.

Ribbons for Trimming

The so-called "ribbons" for trimming, usually produced by the lacquering of textile ribbons, using nitrocellulose or other suitable lacquers, enter notably into the shoe industry. In this instance Igelit gave considerable simplification in production, as by drawing textile bands through coloured Igelit paste and afterwards de-gelatinizing them. Where otherwise the lacquer film has to be repeated to obtain the necessary film thickness, in the case of Igelit paste a single operation is sufficient.

P.V.C. Materials Without Plasticizers

Polyvinyl chloride which has not been plasticized can be used in the production of shoes, especially in the form of Luvitherm ribbons for shoe uppers. In this method the bands are twisted, threaded and woven, and these textiles are given the form of very tasteful leather substitutes which have the advantages of high resistance to ageing, no sensitivity to water, and agreeable colour. However, difficulties are again caused in the attachment to the sole of the shoe.

Owing to the scarcity of polyvinyl chloride products in Germany, such substitutes are of importance, as material consumption is relatively low, and the construction of such a shoe requires only about one-third of the weight of polyvinyl chloride required for any other type of shoe.

Impregnated Fibrous Material

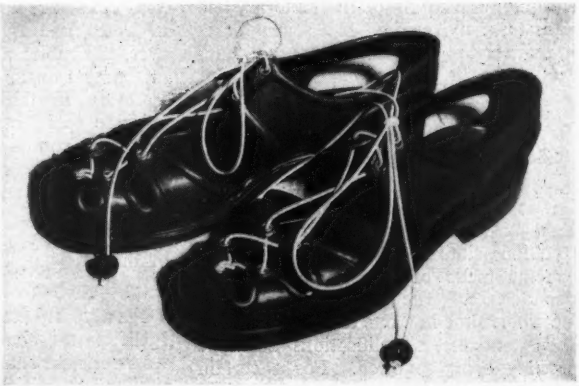
Finally, it may be mentioned that Igelit pastes allow the providing of a wear-resistant surface to soles of straw or similar material. In this method the paste is brushed upon the surface and is then de-gelatinized. Whereas a straw sole with paste fill has a very short life and such a shoe can practically only be worn in the house, straw shoes treated with Igelit paste can be used on the street, at least in dry weather, without giving trouble.

Polyvinyl chloride has manifold possibilities in the shoe industry. Even if it has to be admitted that many of the indicated applications are only dictated by pure necessity, it may be recognized that even for normal times a number of applications remain, and here it gives advantages by providing the population with a durable shoewear of longer life without making higher financial demands.

Manufacture of Polystyrene in U.K.

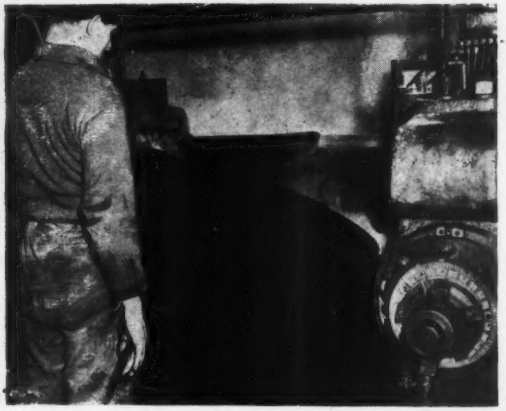
Speaking at the recent Institution of the Rubber Industry dinner, Mr. E. A. O'Neal, Jnr., managing director of Monsanto Chemicals, Ltd., indicated that Monsanto were well advanced in their plans to manufacture polystyrene in the United Kingdom. Mr. O'Neal referred to the successful exploitation of polystyrene plastics manufactured from monomeric styrene, one of the major ingredients of Buna S rubber, and remarked that, in the United States, all surplus plant resulting from the conversion to natural rubber had been fully employed for the manufacture of styrene and polystyrene. At first the monomer will be imported from the United States, but will be supplied later from the plant in the U.K.

Plastic Shoes Produced in Germany



(Above) Plasticized material ready for conversion into pliable sheets.

The useful life of these plastic shoes, introduced to offset the great scarcity of leather in Germany, is said to be about two years. Old shoes are returned to the makers as usable scrap, and the wearer receives a new pair at a reduced price. It is hoped to produce 20,000 pairs per month at the leather works of Carl Freudenberg, in Weinheim.



(Right) Thick sheets are obtained by spreading the soft material on large drying rolls.

(Right) The thick plastics sheet is cut into pieces of predetermined size, and is placed in a pressing machine, where it acquires the shape of the shoe.

(Above) On leaving the press, the shoe is stripped from the inner former (the equivalent of the "last" which is used in shoe-making with leather).

(Right) After trimming, to remove surplus material, the shoe is ready to be examined for imperfections.

Cellulose Acetate Plastics

XVIII.—Fabrication from Sheet

By
Vivian Stannett

THE fabrication of articles from rigid cellulose acetate sheeting and film accounts for something like 20 per cent. of the total consumption of cellulose acetate plastics. It has become an important part of the plastics industry, and some of the methods are reasonably well adapted for mass production. The main outlet for fabricated thin sheet and film is for containers, and it is proposed to deal with this aspect of the subject separately.

In the early days of the war the fabrication of thick transparent sheeting for gun turrets and other aircraft uses grew to be an important industry and a number of methods were developed which enabled the moulding of simple shapes without undue distortion or marring of the plastics surface. Modern aircraft still use a number of shaped parts made from thick cellulose acetate sheet, although most transparent enclosures and hoods are now made from methyl methacrylate.

The chief operations involved in fabricating articles from sheet are cutting, shaping, cementing and finishing, together with some subsidiary processings. Some aspects of these operations will now be described.

Cutting[4-8, 11]

Sheets up to about 80/1,000 in. thick can be cut by hand-shears or by guillotine. Hand- or power-operated guillotines can cut through a whole stack of thinner sheeting, the best types of machine for this kind of work having a foot-operated holding clamp to prevent any movement of the batch of sheeting during the cutting. Very accurate rectangular shapes can be cut in bulk by the use of guillotines and most cutting prior to fabrication is done by this means.

Odd and curved shapes are normally punched out in bulk by means of steel cutting dies used on a press. Very intricate shapes can readily be cut by this method. Material up to about 30/1,000 in. thick can be cut. The best kind of presses to use are power punching presses, the die being fixed to the top and the bottom bed being covered by a thick fibre board sheet.

Most cutting operations, and particularly punching, are facilitated by warming the plastic sheet to about 45 degrees C. before cutting. In this way an easier and cleaner operation is effected. Thick sheeting is best by saw; circular, cabinet, jig, and band saws may all be used.

Circular saws around 10 ins. in diameter, running at 2,500 r.p.m., are often employed. Hollow ground saws with no set are said to be unsatisfactory as they tend to become overheated. Jig saw machines are very useful for cutting irregularly shaped holes into acetate sheeting up to ½ in. thick. A suitable speed for this type of machine is of the order of 550 strokes per minute, the blade being 23 gauge thick, ¼ in. wide, and having approximately 9 to 10 teeth per inch.

Band saws of very high velocity have recently[1] been recommended for sawing very thick plastic sheeting. The use of high velocities enables enough heat to be generated by friction to soften the sheet (or moulded part) and thus to facilitate the cutting operation by the teeth. The sawing technique must be adapted to the particular plastic to be sawn, and the use of band machines with a variable speed range of from 1,000 to 5,000 ft. per min. is suggested. Some figures recommended by Chamberland[1] for cellulose acetate are given in Table 1; for comparison, the figures for a number of other plastics are also given. A slight coat of light

Table 1.—Data for Sawing Plastics Sheet (Chamberland[1]).

	Work thickness							
	Saw pitch				Saw velocity (ft./p.m.)			
	½ in.	2 in.	4 in.	6 in.	½ in.	2 in.	4 in.	6 in.
Cellulose acetate and butyrate	6	4	3	2	4,200	3,700	3,500	3,000
Cast phenolic	6	4	4	3	4,600	4,000	3,500	3,000
Moulded phenolic (fabric and wood flour filled)	6	4	3	2	4,400	3,600	2,700	2,500
Methyl methacrylate	6	4	3	2	3,600	2,800	2,500	2,300
Polystyrene	6	4	4	3	4,700	4,500	4,200	4,000

oil is sometimes applied on to the blade to give a smoother cut, although acetate sheet can be cut dry.

Before leaving the general subject of blanking it might be worth while to treat in a little more detail the process of blanking out shapes from cellulose acetate sheets.

It should be emphasized that, in addition to preparing shapes or blanks for further fabrication work, blanks from thick material are often used directly after finishing, for example in the manufacture of toothbrush handles. These can be cast directly from thick sheeting followed by elaborate finishing by "tumbling."[10, 12] This process rounds and smoothes off the cut edges of the sheet. The operation involves tumbling the pieces in an octangular barrel with a graded series of abrasives. The initial tumbling takes place in a medium consisting of a coarse abrasive. A later treatment uses a medium grade abrasive, and a final operation employs a felt-lined barrel and a polishing compound. Most of the tumbling barrels used in the industry are up to 3 ft. diameter and 4 ft. width.

In effect, the tumbling process is equivalent to a sandpapering and buffing action and each stage takes almost 24 hours, the barrel making about 30 r.p.m. In addition to the abrasive, the barrel contains wooden pegs to help in the rubbing action. Final shaping of a cut and tumbled part of this type is often carried out by moulding, using a shallow mould, and with finishing only a 10 to 15 seconds cycle is necessary.

Three main types of die are used for blanking out, and the choice of type depends on the size and shape required and, in particular, on the quantities required and the economic balance of the job concerned.

Blanking Out Dies[9]

(1) Open Face Dies. These are constructed of tool steel and are about ¼ in. to ⅜ in. thick at their base (blunt) end. It is recommended that a standard height be used for all sizes of die and the figure of 2¾ ins. has been suggested. This standard height gives sufficient clearance in the press for easy manipulation and for the safety of the operatives. Interchanging dies or the use of a number of different sizes and plates in the same press operation is also possible. Finally, such a standardization leads to cheaper die construction. It is normal practice to use this type of die manually and for the operative to move it round at will to make the most economic use of the size of sheet selected. In order for any cut piece to be taken up in the die, the cutting edge should be bevelled.

(2) Steel Rule Dies. These are cheap and extremely useful, especially for limited production runs. Also for large area cuts where a steel open-faced die would prove very costly. The die is made up of ribbon steel bent to shape and mounted on a strong plywood backing plate with the other edge ground extremely sharp. At intervals along the perimenter or inside the die, rubber stops are fitted to hold the sheeting in place prior to cutting and also to serve as ejectors for the cut piece.

(3) Ejector Type Dies. This type is

similar to the open face type, but is fitted with ejector plates consisting of a steel plate fitting flush with the cutter and held there by means of a spring round a guide pin fixed to the plate and running through a guide collar at the other end. These are more expensive but are essential for high-speed blanking. They are usually fixed to the head of the press and the system is often fitted with an air jet which blows the cut piece clear before the second cut is made. In addition to these varieties punching dies are also extremely useful, especially for mass production runs. These consist of an open bottom guide ring fixed to the bottom plate of a press. A moving close-fitting punch cuts the disc or other simple shape, whilst successive strokes drive the cut pieces through the guide ring into a suitable receptacle.

Shaping

A large number of methods have been evolved for the fabrication of shapes from rigid thermoplastic sheet, but the choice of a suitable method usually depends in the final analysis on economic considerations. The most satisfactory method, in the writer's opinion, is the use of well-made male and female moulds of polished metal and of deep drawing for deep moulding in cylindrical and similarly straightforward shapes. The drawing method operates best if, as is usually the case, some provision for slip is made, i.e., for some excess sheet stock to be drawn down by the action of the male die to give a better and more even thickness to the product.

Except for fairly small articles, where very large numbers are required, these processes are too expensive owing to the cost of the moulds, and the use of cheaper and simpler methods is necessary. Again, many articles required are quite large, running to several square feet in cross sectional area, and in this case the cost of accurate metal moulds would be quite prohibitive. To overcome this difficulty, wooden moulds are often used; these give excellent service, although over long periods of time some warping and shrinking is bound to occur. Mahogany and laminated woods are the best materials and can be covered with a short-pile fabric or chamois leather.

For long runs, cast aluminium moulds are more satisfactory. The use of a corresponding female mould is not always necessary and for simple curvatures the hot sheet can be laid on the male mould and pulled over it by means of a large piece of strong and soft cloth attached along one end and, if necessary, the other side can be weighted or clamped down. Sometimes the pulling-down cloth is set in a well-fitting frame and the frame can then be evenly clamped down until the plastic sheet has set—a process taking a few minutes at the most. Another method in which the necessity of a female mould is eliminated is to use a thick rubber or sponge rubber base and to bring down the male mould on to the hot plastic sheet held on top of this resilient bed. An interesting and elaborate modification of this technique is described in the Borkland patent,[3] mentioned at the end of this article.

For straightforward drawing, the use of metal tools is essential. The simple details of the method are as follows: An arbor press can be used, the fixed base being fitted with two plattens, which may be electrically heated and thermostatically controlled. The bottom platten is fixed to the base, whilst the top one is spring-loaded on to the bottom one with sufficient tension to give an even slip without puckering to the plastic sheet as it is being drawn. The punch or male die is fixed to the ram of the press and is normally used cold. The clearance between the punch and the hole in the bottom ring or platten should be about twice the thickness of the plastic sheet, whilst the guide hole in the top platten is made somewhat larger.

In order to facilitate release in the case of a straight die, a few thousandths of an inch taper is normally given to the die, whilst to prevent trapping of air the die may be vented by means of a number of small holes. A hole through the ram

and die is sometimes used to cause automatic ejection by means of a compressed air jet. Above the punch, concentric with it and mounted on the ram, is a cut-off ring having the same diameter as the forming ring. Suitable temperature for cellulose acetate would be of the order of 200 degrees F. for the top platten and 280 degrees F. for the lower platten. Alternatively, the whole tool assembly can be used cold and the sheet preheated before inserting. If the correct adjustment of temperature is made, however, it is found that no cooling period is required and a very fast rate of production can be achieved, using cold sheeting.

Although the principle of the method is extremely simple, it is found that only with accurately made die and die plates and with highly polished metal surfaces in contact with the plastic sheet can any consistent quality and speed of production be maintained, especially when anything more than shallow articles are required. The main use of this type of automatic and semi-automatic drawing process has been for the production of transparent acetate containers, and this aspect will be further considered later in this series.

Blowing[14]

This method of forming was developed many years ago in the celluloid toy and fancy goods trade and is still mainly used for this type of product. It consists essentially of using compressed air or, more rarely, steam to blow a softened sheet into the contours of a female mould. With the more elaborate apparatus, two previously heated sheets are clamped across the join of two female moulds and a jet of air or steam is blown between them; thus a complete moulding is produced in one operation; if the moulds are heated, the join of the two halves automatically seals under the heat and pressure of the mould. All that is then needed to prepare the moulding for use is to trim down the flash.

The type of mould required for this complete type of blowing is more expensive than when the two halves are blown separately and later cemented together. For the latter method plaster and wood dies can be used, and the sheet held against the die by a clamp while the air pressure is applied by means of a simple air chamber. It is usual to vent the moulds by means of one or two small holes drilled in the back. About 20 to 30 lb. of air pressure is normally required. Some manufacturers have adopted a practice of soaking the sheet in a softening solution before blowing, a method which used to be much employed for celluloid blowing. This practice is not necessary for modern well plasticized acetate sheeting and tends to spoil the finish of transparent sheet.

The blowing of the whole object in one, in addition to requiring more expensive moulds, is also sometimes slower than the single-sheet method in spite of the additional operations involved in cementing the two halves together. The reason for this is that considerably less heat is required to mould a single half than to mould two halves and also heat seal the two halves together, and some cooling may well be found necessary in this latter method. Although slower than many other methods, the blowing technique is still widely used, especially for such articles as floating toys, rattles, and similar objects.

More recently,[13] suction has been substituted for blowing in some cases and has certain advantages. For example, a much simpler apparatus is needed and also heating can be applied to the plastic sheet directly—an operation not possible with any other method of moulding.

Ridge Forming[15, 16, 17]

This method was developed by the Rohm and Haas Co. for the moulding of "Plexiglas." The principle of this method consists in using only a framework of the shape required as the mould. It has the advantage that the mould is only in contact with the sheeting at the major shape determining point. This makes it an excellent method for moulding transparent sheeting. The moulds are also very cheaply and easily constructed.

To make a rectangular moulding, the preheated sheet is clamped across a rectangular framework with an opening a little larger than the horizontal cross-section of the part required. Then a framework of the correct size is inserted and pressure is applied to force the sheet down to the shape of the mould.

To avoid undue thinning of the sheeting, the so-called hot-ridge method is employed. This is a modification of the other method in that the mould is constructed of polished metal piping through which steam is allowed to circulate. In this way the material can slip past the ridges as the moulding takes place, giving a more even thickness. This method has been used for very large "Plexiglas" mouldings and also for small objects such as housings, shields, and covers for electrical equipment. There seems no reason, however, why this method should not be adopted for all cellulose acetate sheeting.

A number of other simple methods were developed for forming methyl methacrylate and cellulose acetate shapes. The simplest method of all consists of manual stretch forming, which merely involves stretching of the heat-softened sheet over a male former by hand, using wooden carpenter's clamps. Several operatives may be needed to form a large object by this method. A variation is to use a yoke which grips the sheet beyond the trim line. This is then pulled down over the former, using screw clamps, jacks, or other mechanical means.

An elaboration of this technique is to use a ram on which is fixed the male former and pushing this down on to the sheet held in a clamping ring. This method can be used with or without slit and is essentially a big-scale adaptation of the normal drawing process. Objects such as washing bowls and tubs have been very successfully made, using this method.

Still another alternative is to place the hot plastic sheet over the plug or male mould and to slip a ring over and pull it down. The ring is made to fit snugly over the outside edge of the plug, making allowance, of course, for the thickness of the plastic sheet. Other methods which are mainly used for polymethyl methacrylate sheeting involve free blowing of simple spherical shapes, and the "snap-back" method in which a shape larger than the desired object is blown or sucked, the male former is then inserted and heat is applied, when the plastic sheet collapses back again over the former. This method is said to give a closer reproduction of the contours of the mould than most other methods.

It can be seen from the foregoing that a number of different methods exist for forming thermoplastic sheet. In addition to those described, a large number of other methods are to be found scattered throughout the patent literature. However, the ones discussed here account for the great bulk of commercial moulding now being carried out by the industry. The question of suitable adhesives for cellulose acetate sheet will be dealt with in the next article of this series.

(To be continued)

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Electro-deposition of resins.—C. G. Fink and M. Feinleib, of Armour Research Foundation, have investigated the electro-deposition of synthetic resins from latices. Anodic deposits several millimetres thick were built up rapidly at unusually low potentials, and very high current and energy yields. ("J. Electrochem. Soc.," 1948/Dec./309).

Marking Processes and Media for Plastics—IV

By E. E. HALLS

THE marking of plastics by aid of stencils is notably speedy and economic. Spray application of the marking medium through a simple-cut stencil is widely employed, as well as brush and squeegee methods. Pressure, roller, and squeegee processes for forcing the medium through a fine gauze screen laid closely over a thin-cut stencil represents another type of process. The inks cover all the plastic classes; cellulose media, air-drying oil media and air-drying synthetic media; the latter, including alkyd resin types in particular, are extensively used.

Spray Stencilling

The spray stencilling process consists in cutting the marking, design or other pattern in a thin rigid material, which may be metal or paper, laying this in close contact with the work surface, and applying the medium through the stencil with an air pressure spray gun.

Metal stencils are most commonly used, and are certainly best for continuous work or long production runs. They are robust, not easily damaged, do not suffer any wear, and are easily cleaned, the latter being necessary after a number of applications. Metal thickness is chosen to suit the size of the job, and may range from 0.005 in. to 0.016 in.; 0.008 to 0.010 are most popular. Half-hard or hard-bright mild steel is suitable for continuous use, if rusting is not likely to occur, but brass or nickel silver in the same temper are also used, because these are free from any corrosion troubles. The material cost in relation to the expense of cutting the characters or design is small. For very large areas, such thin material may not be sufficiently rigid, so that either a heavier surround is provided, or the stencil is made from heavier gauge material to serve as the mask, and it is cut away with suitable insets of thinner metal carrying the cut out design.

The stencil generally can be quite small, only a little larger, in fact, than the area to be marked. It can have a small surround embodied, this being of thin gauge metal, to protect the surround areas of the object from marginal spray. This surround can be at an angle of from 120 to 135 degrees to the main stencil surface.

The stencil may be placed flat or flush on the surface of the object, with simple locating pins or edges, according to the surfaces and marking concerned. Alternatively, it may be fixed in a jig, and the object brought up to the stencil from beneath against appropriate location stops. The plane of the stencil may be either horizontal, sloping or vertical, but 45 degrees to the horizonal is a good value to work to when convenient.

In many cases paper stencils are efficient and economic. A good stiff paper, such as manilla, of thickness from 0.005 to 0.008 in., is used. The pattern, if comprising numerals and characters, is cut on an addressograph type of machine, for which any kind of type can be provided. The paper stencils are stiffened along their two shorter sides with thin card secured with adhesive.

These paper stencils can be treated in the same way as metal ones. They have very good resistance to wear and tear and can be washed periodically in solvent to remove the marking ink. They are very useful for periodic runs of wide varieties of work, because, being made so cheaply, they can be scrapped at the end of the run: this saves an elaborate filing system.

Plastic stencils, e.g., of cellulose acetate

sheet, may also be employed, provided the material is chosen as one upon which the solvents in the ink have no other solvent action. For general purposes, however, they have no advantage over metal or paper.

The application of the ink may be by hand or automatic. Manual operation of the spray gun is usual for small markings applied individually. A low-pressure small size gun is preferable, such as the M.P. or M.P.S. models of the Aerograph Co. The nozzle and needle of the gun suffers very little wear, so that maintenance is negligible. Thorough cleaning of the gun with solvent at the end of each run or shift is, however, essential. The stencils require cleaning at very frequent intervals.

For continuous operation, it is practicable to pass the work on a conveyor beneath a fixed gun, or guns, which cover the area to be stencilled. Alternatively, it is more convenient in some cases to traverse the gun to and fro over the work, the gun being automatically started and stopped as it approaches the start and finish of the work by means of tripping levers. The medium sprayed is advantageously kept agitated. This is most conveniently achieved by a tiny propeller-type stirrer carried through the cover of the "paint" reservoir, which gravity feeds the gun.

The Aerograph Co.'s model M.P. gun is exceptionally light in weight and is provided with alternative nozzle sizes. As the air pressure required for operation is low, and volume small, when a compressed-air line is not available, carbon dioxide or nitrogen from cylinders may be utilized.

Table 1.—Pigmented Cellulose Lacquers for Stencil Spraying.

Colour	Volatile spirit (loss in wt., 3 hr. at 110° C.), per cent.	Total solids (pigment, nitro-cellulose and resi..), per cent.	Specific gravity at 25° C.	Viscosity at 25° C. (centi-poises)
Black (1)	89.1	10.9	0.9.2	32
B.ack (2)	75.3	24.7	0.948	125
White ..	64.5	35.5	1.014	168
Red ..	74.2	25.8	0.958	138
Green ..	72.3	27.7	1.008	127
Yellow	74.0	26.0	0.998	123
Blue ..	77.5	22.5	0.962	152

Cellulose enamels are the preferred inks for spray stencilling, because of their easy application, easy gun cleaning, and, above all, rapid drying time. In thin coatings, they dry almost as applied, and when applied to clean surfaces, the adhesion is good. When sprayed on to moulded phenolics or amino resin plastics, having their natural high gloss surfaces, it is advantageous to degrease the articles in a trichlorethylene vapour degreaser before stencilling. This removes any mould lubricant or any greasiness that may have been acquired by handling and ensures strong adhesion. If such a degreasing plant is not available, it is satisfactory to wipe over the areas concerned with a cloth moistened with solvent naphtha or with a regular cellulose thinners, provided that the latter is not too volatile a type.

Thermosetting laminated materials can be advantageously cleaned by one of these methods before stencilling. Surfaces that have been matted, as by abrasive blasting or straight graining, give even more tenacious adhesion, although they must also be clean.

Table 2.—High Flash-point Grades of Pigmented Cellulose Lacquers or Enamels for Spray Stencil Application.

Colour	Volatile spirit (loss in wt., 3 hr. at 110°C.) per cent.	Total solids (pigment, nitro-cellulose and resin) per cent.	Specific gravity at 25°C.	Viscosity at 25°C. (centipoises)	Flash point (closed) Degs. F.
Black	84.6	15.4	0.913	150	89
White	80.2	19.8	0.943	550	88
Red	81.4	18.6	0.919	145	87
Yellow	74.7	25.3	0.986	176	89

For best adhesion on cellulose acetate plastics, the cellulose enamel solvents should contain a small proportion of acetate solvent, such as acetone. This ensures mergence of the sprayed film with the base material and a lasting bond.

When special fire precautions have to be avoided, the cellulose enamels can be procured in high flash-point grades. Laboratory characteristics of the two grades of material are given in Tables 1 and 2. They are obtainable in a wide range of pigmented colours, shades being preferably selected to B.S.381. They comprise a nitro-cellulose base and pigment thoroughly ground into a mixed vehicle consisting of cellulose nitrate solvent (e.g. butyl acetate) and hydrocarbon diluent (e.g. benzene or xylene). Grinding is exceptionally fine to give a smooth mix, and the total solids and viscosity are not unduly high, thus facilitating spray application through small nozzles.

The air-drying oil-type of stencil ink is an orthodox enamel, very much more heavily bodied than the cellulose type. For this reason, more frequent cleaning of the stencils is necessitated, cleaning after every three applications as against 10 for the cellulose enamel, being typical values for guidance. Cleaning of guns also needs to be more frequent. The applied film requires longer drying, and although it is surface-dry within a very few minutes of its application, 24 hours must be allowed for full drying. Excellent adhesion is obtained on the thermosetting products without any adjustment of formulation, although this can be modified with appropriate solvent addition to best suit the thermoplastics.

Synthetic base enamels are also available and give good results; they are generally oil-modified alkyd resin types, suitable for spray application and air drying. Comments are as given for the air-drying oil enamels, and grades are illustrated in Table 3.

When the cellulose base enamels are used, it is sometimes advantageous to apply a top coat of lacquer. For this purpose the brush or spray cellulose transfer varnish, already described, can be employed. Alternatively, any good grade of low viscosity clear colourless cellulose lacquer may be applied by spray as a thin film.

Table 3.—Air-drying Oil Base Stencil Spraying Enamels.

Colour	Volatile spirit (loss in wt., 3 hr. at 110° C.), per cent.	Pigment, per cent.	Oil and gums, per cent.
Black ..	45.3	2.1	52.6
White ..	20.5	65.3	14.2
Red ..	18.5	67.0	14.5
Yellow ..	22.0	60.8	17.2

Stencil enamels can be purchased to specification, the following main features applying for the cellulose grade:—

(a) Material to be a pigmented cellulose enamel of low consistency, ground extra fine for application through small nozzle stencil spray guns.

(b) The sprayed film to be tenaciously adherent to plastics, including the natural glossy surface of thermosetting resin mouldings and laminates.

(c) Colour to be stable upon exposure to light.

(d) Material to be miscible in all proportions with regular cellulose enamel thinners.

(e) Total volatile spirit, determined on a 5 gm. sample, heated in 3-in. diameter aluminium dish for three hours at 110 degrees C., not to exceed 90 per cent. for black grade, and 80 per cent. for other coloured grades.

(f) Total solids (pigment, nitrocellulose and resins) not to be less than 10 per cent. for black grade, and 20 per cent. for other coloured grades.

(g) Material to be suitable for spray application at 15 to 30 lb. per sq. in. air pressure, using an Aerograph M.P. spray gun.

(h) The film sprayed as in (g) to be hard-dry within 10 mins. at room temperature of 20 to 25 degrees C.

(To be continued)

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

"Design and All That"

Sir,—I would like to say how very much I enjoyed reading your editorial in the January issue of "Plastics" on the subject of "Design and All That." I certainly feel you have put your finger upon a very elusive spot. The results of your penetrating interview with artist-designer George Fejér are very illuminating. Quite revolutionary developments in the art and practice of competent design could eventuate from an ordered extension of this sort of open-mindedness between artist and designer.

I feel sure that this break of yours into a new field should encourage others to share their views on the raison-d'être of design forms and the reasons why certain kinds are evolved in preference to others.

One of the most surprising, pleasantly surprising, things I observed from the interview with Mr. Fejér was the revelation of the practical viewpoint constantly held in mind by the artist-designer. Until reading this account, I confess that I, as a practical man, rather thought that the artist-designer was up in the clouds, and dwelt in realms chiefly inhabited by æsthetic values, and forms! It comes as a shock to realize that they can be as severely practical as we imagine ourselves to be!

As a corollary to this interview with the artist-designer, I am wondering whether it would not be equally interesting to ascertain what goes on in the mind of the practical engineer-designer when he evolves a design. His great limitation is that he so rarely pays any attention to æsthetic values, indeed, often by training he is incapable of doing so. As a result, the engineer-designer manages to produce articles capable of being economically moulded and able to fulfil their functions as regards strength, wear, and in other physical respects, but which so often are sadly deficient in the finer points surrounding appearance, colour blending, and eye appeal. All too often he tends, too slavishly, to copy shapes and forms from articles produced in other materials.

W. M. HALLIDAY.

Southport, Lancs.

Colours

Sir,—I would refer to your excellent editorial in the January issue of "Plastics," and, in particular, the section headed "Colours." Your reference to and comparisons with pottery were of special interest, since, living in this area, one is inclined to become pottery-minded.

Whilst agreeing that design is an important factor, the correct use of colour is at least of equal importance and must apply not only in the artistic sense but to the relative permanence of these products. The use of colours which are fugitive is literally unknown in the ceramic industry, applying equally to the finest china down to the lower grades of earthenware, but, unfortunately, this does not appear to apply in the case of the plastic industry, and I would add that this observation does not refer solely to plastic table ware, but to numerous other products in which colours have been used.

If domestic ware, tea cups, etc., lose their colour during the short time they may be displayed for sale, one can understand the views of so many people who insist that plastics are "something new," "a novelty," "they will not last," etc. I well recall visiting a plastics publicity exhibition and noticing that curtain drapings, whilst very attractive, had, in fact, lost their colour, presumably during the short time exposed at the exhibition.

It is realized that these remarks may

be open to criticism, but I venture to suggest that colour, correctly used, can and will sell the idea of plastic, but finished products which fade or vary from their original colour, must have an adverse effect, and possibly result in the condemnation of something which otherwise is absolutely sound.

E. LEADBEATER.
Blythe Colour Works, Ltd.,
Cresswell,
Stoke-on-Trent.

Sir,—You ask whether a solid, vivid red cup and saucer accords with art. It can do, provided the curtains, carpet, the walls and the furniture are so devoid of pattern and colour that they are not noticed, in which case everybody's eyes will fasten on and gloat over the richness of the cup and saucer. The trouble is that the designers and manufacturers of all these furnishings are not likely to embrace drabness in order that the spotlight rests on the plastic product. This calls for compromise, and means that no industry should throw a pot of paint at another industry. So vivid red cups and saucers automatically are out.

L. G. BARNES, N.R.D.
High Wycombe, Bucks.

Dip Coatings for Tools

Sir,—One of our customers, a manufacturer of turning and planing tools, etc., made of high-speed steel, intends to coat these tools with a plastic layer before dispatch and storage. This layer has to be applied and afterwards removed in an easy way, and should have good mechanical properties.

We should be glad to have information on the following points:—

(1) What is the least expensive material to be used for this purpose, and how can this material be applied?

(2) Names and addresses of English firms who are in a position to furnish this material.

N. V. HANDELMIJ, R. S. STOKVIS
Rotterdam. AND ZONEN.

[EDITOR'S NOTE: Ethyl cellulose, modified with various compounds to lower the melting point, is one of the best-known coatings for the protection of valuable metal objects during storage or transport, especially in tropical countries. Application is by simple dipping in the mixture maintained by heat in the fluid form. Manufacturers of this type of compound are:—Courtaulds, Ltd., Plastics Division, Coventry; Glostics, Ltd., Gloucester ("Gloscoat"); Birmingham Tool and Gauge Co., Ltd., Handsworth, Birmingham, 19 ("Safepak"). Another type of dipping compound is "Vinamold," made by Vinyl Products, Ltd., Carshalton, Surrey; this should also prove valuable. Exact details of procedure can be obtained from each of the above concerns.]

Cutting-off Machine

Sir,—We are anxious to obtain a progressive cutting-off machine, i.e., a machine with a moving head which will traverse at the same rate as an extruded material and cut that material to a predetermined length, the rates of extrusion being 40 ft. per min., and the minimum length 4 ins., with a diameter of from ¼ in. to 2 ins. We should be grateful for any information you could give us on the manufacture of this equipment.

DE LA RUE INSULATION, LTD.
West Chirton,
North Shields.

Bowls for Florists

Sir,—We are seeking supplies of plastic bowls of varying sizes, shapes and designs for use in the florists' and horticultural trades as posy and bulb bowls. If, therefore, you are able to suggest names and addresses of manufacturers who may be able to supply small or large quantities, we shall be greatly obliged.

Also, we are desirous of obtaining a machine for the printing of inscriptions similar to the sample enclosed. If you could put us in touch with a supplier of this type of machinery we should be indebted to you. DAVID POTTS.
Sheephill Lane,
New Longton,

[EDITOR'S NOTE: Several manufacturers make a variety of flower bowls and we hope these will communicate with the inquirer directly. Such bowls are made of

(Continued on page 111.)

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

POWER-OPERATED PALLET TRUCK. The all-British power-operated pedestrian-controlled pallet truck newly introduced by Lansing Bagnall, Ltd., Worton Road, Isleworth, Middlesex, has a turning radius of only 49 ins. The standard model has a maximum capacity of 4,500 lb., and weighs only 10 cwt., with forks 36 ins. long and 27 ins. wide. The height of the forks in the lowered position is $3\frac{3}{8}$ ins., with a power lift of 4 ins. The vehicle is claimed to be ideal for female and junior operators; operation is simple, and all controls are situated in the handle. Twist-grips control the speed of movement. A finger switch gives forward or reverse and a small key switch is provided for immobilizing the vehicle. To apply the brake the operator merely raises the handle to the vertical or lowers the handle to a horizontal position. In the event of the operator slipping and losing hold of the handle, the latter automatically springs to the vertical position, thus applying the brake and switching off the driving motor. When fully loaded, the truck will negotiate gradients up to 1 in 12.

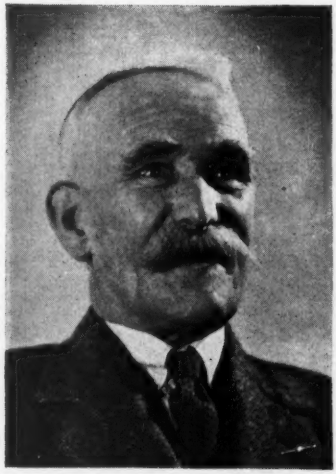
TENAPLAS EXTENSIONS.—The problem of how to provide greater handling length for polythene and p.v.c. extrusions has been met by Tenaplas, Ltd., of Upper Basildon, Berks., by the erection of a new factory building of 5,700 sq. ft. Work on the modern steel-framed single span building has begun; the building will accommodate 16 extrusion machines. The company are doing the construction work themselves, and as much as possible of the pipework installations will be carried out in their own extruded polythene and hard p.v.c. pipe. Conveyor systems will be used for handling both raw materials and finished products.

BRITISH INDUSTRIAL PLASTICS, LTD.—The directors recommend a dividend for the year to September 30 of 20 per cent., less tax, payable on April 8. After a series of 8 per cent. dividends, the company paid 12 per cent. for 1945-46 and 20 per cent. for 1946-47. After transferring £10,000 to stock reserve, the carry-forward is £34,882. Aggregate profits of the group amount to £342,373. After charging depreciation £110,538 and taxation £141,595 the net profit is £90,240 (previous year £80,231).

CATALIN, LTD., inform us that during 1948 every endeavour has been made to lower production costs, and this combined with the replanning of manufacturing technique, has enabled the company to achieve a considerable saving, which is being passed on to customers. As from February 1, 1949, prices of the company's products are reduced by approximately 15 per cent

MONSANTO CHEMICALS, LTD.—Mr. Edward A. O'Neal, Jnr., managing director, has been appointed chairman of the board of directors, in succession to Dr. L. F. Nickell, whose resignation was recently announced. Mr. O'Neal came to Great Britain as deputy managing director of Monsanto Chemicals, Ltd., in February, 1946, and in April, 1947, was appointed managing director.

LACRINOID PRODUCTS, LTD., with profound regret, announce the death, on Christmas Day, of Mr. Harry Allen, works manager, who served the company so faithfully during 26 years, and had suffered many weeks of severe illness.



Mr. Peter Paskell, who has just retired after working for 50 years in the Brantham factory of BX Plastics Ltd., was awarded the British Empire Medal (Civil Division) in the New Year's Honours. Born at Manningtree in 1883, he went to work at the Brantham factory at the age of 14. Eventually he became a highly skilled calender operator, dealing with mottled and configurated xylonite.

BEECHFIELD PRODUCTS, LTD., 10, Union Court, Wormwood Street, London, E.C.2, manufacturers of welded-plastic articles, announce that Lord Westwood has been appointed chairman of the Company.

MR. J. R. SEVERN has joined British Artid Plastics, Ltd., as sales manager. Mr. Severn has been associated with the plastics industry for some years and was formerly with the Streetly Manufacturing Co., Ltd.

PLASTICS INDUSTRY GOLFING.—A meeting of the North Western Section of the Plastics Industry Golfing Society will be held at the Wellington Hotel, Nicholas Croft, High Street, Manchester, on March 4, at 7.30 p.m., with the object of forming a committee and of making arrangements for the coming season. Golfing members of the plastics industry will be welcomed.

NOTES FROM THE BRITISH PLASTICS FEDERATION

Spring Conference

The North-West Sub-section of the Moulders Group are holding a Spring Conference at Armathwaite Hall Hotel, Bassenthwaite, near Keswick, March 24 to 27. The programme includes a visit to the works of Hornflowa, Ltd., at Maryport (Friday, March 25), followed by lunch at the works, and also a dinner and dance (Saturday, March 26), by invitation of Hornflowa, Ltd. The Sub-section Dinner will be held at Armathwaite Hall Hotel on Friday, March 25. There will also be a visit to the works of British Rayophone, Ltd., at Wigton, on Friday afternoon.

FORTHCOMING MEETINGS

Feb. 14.—"Natural and Synthetic Polymers." W. J. Naunton (I.C.I., Ltd.). S.C.I., Plastics Group. Joint meeting with Plastics Institute, London Section. Victoria and Station Hotel, Preston.

Feb. 16.—"Plastics and the Oil and Fermentation Industry." Plastics Institute, London Section. Joint meeting with S.C.I., Plastics Group. Waldorf Hotel, Aldwych, W.C.2.

Feb. 16.—Discussion. Plastics Institute, Western Section. Wheatstone Hall, Brunswick Road, Gloucester.

Feb. 16.—"Æsthetics and Industrial Design." Gordon Russell. Plastics Institute, Southern Section. Polygon Hotel, Southampton.

Feb. 16.—"Engineering as Applied to the Plastics Industry." L. N. Jones (Alfred Herbert, Ltd.). Plastics Institute, Yorkshire Section.

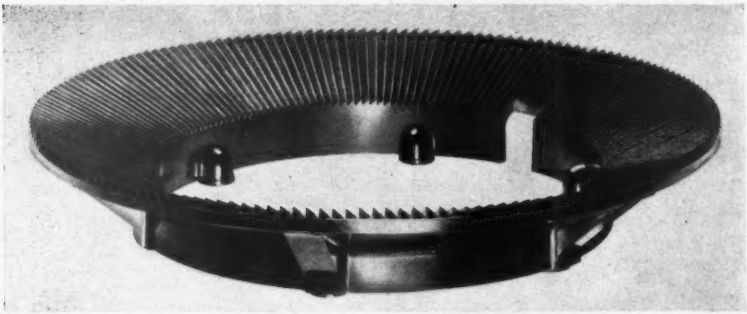
Feb. 16.—"Petroleum Hydrocarbons as Raw Materials for the Plastics Industry." H. M. Stanley (Distillers Co., Ltd.). S.C.I., Plastics Group. Waldorf Hotel, Aldwych, W.C.2.

Feb. 18.—"Phenolic Resins." E. G. K. Pritchett (Bakelite, Ltd.). Plastics Institute, Midlands Section. James Watt Memorial Institute, Birmingham.

Feb. 18.—"Sales—What the Buyer Wants under Changed Conditions." C. S. Dingley. Plastics Institute, North-Western Section. Engineers' Club, Albert Square, Manchester, 2.

Feb. 21.—"Standardization of Instruments." G. P. Clay. Society of Instrument Technology. Manson House, Portland Place, W.1.

New Productions from the Moulding Shops

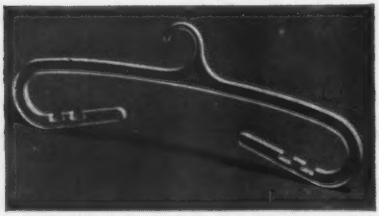


Gear Ring

Moulded in phenolic material, this gear ring measures 14½ ins. in diameter. It was made by British Moulded Plastics, Ltd., for Mellor Bromley and Co., Ltd., air conditioning engineers, of Leicester. The satisfactory functioning of the equipment of which it forms a part, depends to a large extent upon the accuracy of the 180 radiating teeth. The moulding of the ring did not offer any particular difficulty apart from the usual one of controlling shrinkage and preventing distortion. The machining of the teeth, however, was a technical achievement of some note, and reflects considerable skill in toolmaking. Any attempt to do the complete job by moulding would have introduced difficulties due to possible imperfect flow of material to the extreme edge of each of the teeth, especially if some special fabric-filled moulding material were being used.

Dress Hanger

Polystyrene is used for this injection-moulded dress hanger which has been specially designed by Mr. John W. Waterer for the "Taycall" hand-wardrobe case in the "Watajoy" range of travel goods made by S. Clarke and Co., Ltd., Clerkenwell, E.C.1.



Denture Receptacles

These receptacles for the cleansing of dental plates are made in polythene. The advantages of this material from the non-corrosion aspect have already been stressed in these pages. Polythene is inert to all chemicals and does not stain nor fade; consequently, there is no risk of deterioration in

contact with denture cleansers. Moreover, being soft and tough, it cannot injure the dentures, nor chip or crack even with severe handling. Supplied in white, cream, green, red, yellow and mottled shades, these denture receptacles are a product of Tamworth Plastics, Ltd., Alders, Tamworth, Staffs, who are makers of other polythene goods.

Quality Control in Plastic Moulding—XV

By W. M. HALLIDAY

In this article consideration is given to the question of inspection personnel, and the need for careful training of inspection staffs, and machine operators in quality control methods.

To a great extent the successful application of quality control depends upon the availability of correct gauging equipment. A description is given of a simple yet effective scheme for the efficient control of the use, movements, and regular testing of all inspection gauges.

Finally, a few general observations are offered which will prove helpful in guiding those wishing to install quality control type of inspection into plastic moulding activities. A short review of some interesting and useful books and booklets for the guidance of those desiring further knowledge of quality control procedures, will be given in the next instalment.

IT will have been observed throughout the preceding discussions upon quality control principles and methods, that the role and functions of the inspector under such a system of inspection are completely different from those normally associated with more conventional forms of component inspection. This distinction, indeed, marks the chief characteristic difference between the two methods.

Inspectors under quality control practice are responsible not only for ensuring that the quality and accuracy of the finished work is *maintained after inspection*, but primarily that the manufacture of faulty, defective or scrapped work is not allowed to occur without being detected at a very early stage in the production sequence. It is not a question of determining whether a batch of components produced some time previously are right or wrong, but rather of observing whether the tendencies of the production flow from any machine or mould, at any given instant, are such as to lead to defective work being produced.

By this it will be seen that the functions of the inspector are considerably extended and rendered far more important, because upon his vigilance and care will depend the general quality of a production. Times will occur when the inspector will have to stop production from a mould because the quality of the finished product has passed beyond the control limits. The persistence and seriousness of isolated or recurring faults throughout a production operation will therefore be one of the main points to be observed by the inspector, and a great deal depends upon his trained judgment and integrity to the system of inspection.

In view of these far more important functions to be fulfilled by the quality control inspector, a word or two about the selection and training of inspection personnel will, no doubt, prove of interest.

Selection and Training of Inspection Personnel

When quality control methods are being first introduced into the moulding shop activities, it will, of course, be necessary to commence with the existing inspection staff and facilities. As was mentioned in an earlier section, considerable resistance may sometimes be encountered when effecting such a change-over from customary and time-honoured inspection practice to the new quality control type. Therefore careful steps will have to be taken by the production moulder to overcome, or neutralize, the effects of any passive or active objections harboured by an inspector.

In such circumstances where there is a likelihood of resistance to the introduction of quality control, it will be found that the best course is to make a gradual and almost imperceptible application of the system, rather than a sudden and drastic changing-over of methods.

In this way the existing inspection personnel will become almost unconsciously re-orientated in outlook and attitude to the requirements of the new system of inspection.

It is far better if special inspection staffs can be introduced and trained for operation under quality control methods, as it is then possible to start with individuals who are relatively free from preconceived notions and assumptions about the efficacy of quality control in comparison with usual and old-time inspection methods. As new members of the inspection staff have to be introduced from time to time, much can be done in the way of training, and the author strongly urges the provision of some simple training scheme along the following lines.

Every additional inspector required should be given a short probationary term of training to give him an understanding of the principles upon which quality control inspection is based, the objectives sought, and the advantages to be derived.

Such a training would naturally include an explanation and practical illustration of the manner in which control charts are constructed and applied to production work proceeding through the moulding shop. Instruction should be given in the proper manner in which such charts are to be compiled, stressing, of course, the importance of honesty and care in plotting the charts. Training would also be given in the correct use of all gauging equipment applicable to the various jobs passing through the works.

The would-be inspector, being trained, should also be instructed in the importance of the collected data contained on the completed control charts. Generally, the more he knows and understands of every practical aspect of quality control procedures the better. His attitude to the scheme of inspection, and his value as an inspector, will be vastly improved by such knowledge, in comparison with his usefulness as a mere manipulator of a gauge.

It will also be found very helpful if such a training activity were to be extended to cover every new employee, whether he is to be an inspector, or a machine operator, or mould setter. The training of such latter personages would, of course, be simpler than in the case of an inspector, but it should cover the essential features of the quality control scheme, and particularly instruction in the interpretation of the control chart. Rightly interpreted, the control chart can become an extremely useful guide to the moulding machine operator. Given a correct understanding of the charts, it will often happen that the operator will observe the trends towards errors, etc., and himself will be able to assign the cause and effect a remedy. Where this obtains, numerous shut-downs of the machine and operation will often be eliminated and much time saved.

Time and attention expended upon operator training in this way will usually be amply repaid at a later date. All such training and instruction should, of course, be conducted under the supervision of the chief inspector and the moulding shop production engineer. Their chief objectives would be to create the proper and sympathetic understanding in the mind of the person. Naturally, in carrying out this task the treatment and methods of approach will have to be varied and suited as far as practicable to the personal capacities and ability of the trainee.

Trainees may have to be carefully selected for their degree of observation, carefulness and interest. Their individual psychological reactions will also have to be carefully considered and adjustments made to suit in the training methods applied.

Control of Gauges

The proper and orderly control of all gauging tools or measuring equipment required for checking the moulded components is absolutely imperative to the successful operation of quality control inspection.

It will be essential to keep proper track

WKS. ORDER	TITLE OF GAUGE	GAUGE REF. No.	NAME OF COMPONENT	QUAN.	DATE	19....

DATE OF ISSUE	TO WHOM	DATE RETURN	INITIAL	GAUGE CHECK	RESULTS OF CHECK	INITIAL

GAUGE TO BE CHECKED	NOTES	REF. NUMBER OF MASTER GAUGE

Fig. 1.— Specimen "Gauge History Card" as employed for the record system which is here described.

of all movements of every gauge to ensure that it remains in safe keeping and is being properly used. Steps will have to be taken for periodical examinations of every gauge or measuring device employed by inspectors, to discover whether wear has occurred, in use leading to errors.

Records will also have to be kept of all details regarding each gauge, so that it can be easily identified both in the stores and in relation to the component for which it is required. All gauge adjustment and repair activities will require careful recording to ensure maintenance of tools to the necessary standards, and to fix responsibility. In view of the great importance of this aspect of quality control inspection practice, a brief description is here given of the gauge-controlling methods employed by a firm of the writer's acquaintance. This will prove interesting and perhaps suggest, to those desiring to introduce quality control methods, other ways and means for achieving the closest control over the accuracy of gauging equipment.

Complete check on the location of every gauge was maintained, as well as a record of its condition at any given moment. This was accomplished by means of a simple card-index system installed in the tool and gauge stores of the moulding shop from which gauges, etc., were regularly drawn by the floor inspectors.

Immediately a newly completed gauge or measuring instrument for checking or inspecting a moulded article is issued to the stores to await production service, a "history card" is made out to contain all the essential information needed for identifying the gauge and job, and its subsequent movements. Fig. 1 illustrates more precisely the kind of information to be recorded and the convenient manner in which it is performed. The cards are standard size, 6 in. by 8 in., stacked in suitable wooden containers. Each card is numbered in the top right-hand corner and also dated for the time of its first issue. This date will, of course, be the same as that on which the gauge or tool was first passed as correct for inspection usage.

Along the top edge of the card spaces are provided for describing the works order number of the job for which the gauge is required, the title of the gauge, its reference number, the name of the moulded article, and the quantity of mouldings on order. Immediately underneath these horizontal spacings the card is ruled in the manner shown, to provide a number of compartments.

Commencing at the extreme left-hand side, these compartments are headed in the following order: Date of issuing the gauge for production inspection, to whom it is issued, when the gauge was returned to the tool stores, and the initials of the person making such a

return. Ten vertical spacings are provided underneath each of these four headings. This allows for 10 issues of the gauge. At the right-hand side of the card, spacings are provided vertically underneath each of the three following headings. Date on which the gauge, etc., was checked for accuracy and quality, the outcome of such a check, and the initials of the person doing the checking.

Underneath these spacings at the bottom left-hand side of the card is a panel, in which has previously been entered the maximum continuous period which the gauge, etc., must be retained in production service before a check is made as to its suitability or accuracy. A sufficiently large blank space is left at the lower right-hand side of the card for bearing any notes or data relating to the gauge, which the inspector, or tool stores superintendent, may consider advisable to have permanently recorded for future guidance.

Batches of these cards of six different colours are employed to conform to the following useful colour code, which was adopted for facilitating the keeping of these records, and especially for ensuring that a gauge was not continued longer in use than the prearranged period laid down for checking. Red cards were used for all gauges where it was decided that a check for accuracy and quality should be made no less than once per week. Blue cards were used for recording details of those gauges to be checked bi-weekly; green cards for those needing a monthly check; yellow cards for those to be tested bi-monthly; orange cards for gauges to be checked once per three months and upwards; black-edged for "stubborn," faulty gauges. Each set of coloured cards was boxed separately. The respective boxes were coloured appropriate to the cards therein for ready selection.

Determination of the length of time which a gauge had to be retained in production inspection service before being withdrawn for a thorough check was, in the instance now being considered, effected by the mould designer and the production moulder, prior to production starting up on any new moulding job. The length of this period was largely controlled by the degrees of fineness of the tolerances imposed on the moulded article, the total quantity of components to be produced, the number moulded per hour, the type of gauge employed, and similar important details.

Having determined this figure for each job, a special instruction from the design office was passed to the inspection department and the tool stores, so that this vital information was available for entry upon the gauge history record cards in the manner just explained.

This has proved an extremely valuable and reliable method for recording the condition of all gauges, for keeping a check upon their accuracy, and for ensuring that no gauge, etc., is continued in use or issued for production inspection on the shop floor for an unsafe period without being checked within the period stipulated at the outset.

The task of identifying gauges is also very greatly simplified. Particularly is this so in those cases of a moulding shop where large numbers of gauges and other measuring tools, etc., are in normal use each day, and where it is imperative that the right gauge for each job be issued to the floor inspectors.

It will be well appreciated that in the case of a very large plastic moulding concern turning out thousands of mouldings per day, most of which have to be regularly gauged in some manner, the knowledge of the exact whereabouts of every gauge, and whether it is being appropriately used, is of inestimable importance if errors and faults are to be avoided. In such circumstances, unless the gauges, etc., are arranged on an ordered basis with regard to their issue to inspection, periodical testing, overhaul and correction, etc., numberless mistakes and delays may occur, with the attendant risks of defective, or even scrapped, mouldings getting by.

To illustrate the several advantages, a brief consideration of the main features of this recording scheme will be found helpful.

Taking first the several identification details contained at the head of the history card. The mere fact of permanently recording the job number, reference number of the gauge, the name and reference of its associated moulded component, etc., tends to eliminate guesswork and confusion. It leads to the correct issue of the proper gauge for each job. In those cases where a master testing gauge is provided, against which all production and inspection gauges have to be tested for accuracy or other quality, the reference number of this vital part should be inserted in the small panel provided in the extreme bottom right-hand corner of the card. This serves for all future reference and eliminates all doubt as to whether a production gauge is correct or not.

By referring to this card index it is possible to tell at a glance almost exactly where any particular gauge is located, viz., whether it is lying in the tool stores or in use on the shop floor, how long it has been there, or whether it is in the testing room undergoing a check or adjustment. Moreover, it is also possible to determine whether any gauge is being continued in use for a longer period than has been laid down before a test is made as to its accuracy, etc. This record also shows clearly whether a gauge is ready for issue to the inspector on the moulding shop floor, or whether it must be passed to the testing department for one of its usual checks.

Suitability of a Gauge

By recording details of the checks made, and the nature of any corrections in the manner illustrated at Fig. 1, a very complete history of the behaviour and general suitability of a gauge is obtained. Obviously, where a gauge has to be substantially overhauled or adjusted, or altered at each periodical check, this information will speedily afford an indication either that the gauge is being subjected to abnormally severe use or else it is inadequate in construction or inferior in design for the purposes required. Thus this record, if made available to the tool designer at frequent intervals, will demonstrate to him the need for an improved form of gauge or a different gauging process, or the introduction of some simple modification to ensure longer life and greater freedom from serious wear and error.

In the large moulding shop particularly these are very important points, which, unfortunately, are scarcely ever properly organized in the way just described. All too frequently the vital decision as to whether a gauge or measuring tool employed by an inspector is the most suitable, or accurate for the purpose, is left to chance after the first introduction of the device has been made. It sometimes happens that countless plastic mouldings are produced and checked in somewhat indifferent fashion before some person has occasion to decide that a better gauge could be applied, or that the one being used is unsatisfactory in some respect, and should be improved along certain lines.

The record system also eliminates all those cases of doubt as to whether a gauge needs repair and resetting or not These occasions repeatedly arise in the moulding shop, and usually the decision has to be taken by the floor inspector. This is sometimes only reached when quantities of mouldings have been passed, presumably as correct, but which are later found to be faulty in some respect not fully revealed by the gauge.

To a large extent the inspector is thereby relieved of this onerous duty of deciding when a gauge needs checking or correcting. Since such activities are placed upon an ordered basis, with checking and testing being performed regularly to suit the needs of each gauge, the likelihood of tools being kept in use longer than desirable will be obviated. From this angle again, errors in the finished product will be still further reduced and the quality of the inspection raised.

After such a scheme has been in operation for an appreciably lengthy period, it will also be found that quite a mass of interesting data is accumulated concerning the gauging tools in use. Any unusual or untoward feature arising in connection with the use, wear or correction of a gauge should be entered into the history card under the "notes" heading. This information will often be found of great guidance to the mould designer and those responsible for the manufacture of the gauges, by indicating to them the undesirable features of existing gauges which give the most trouble, and which features should therefore not be duplicated on any new gauge designs.

Speedy Detection of Faulty Gauges

As each new gauge is issued to the tool stores the record card is immediately compiled, and all the permanent data inserted into the appropriate columns. The colour of the card is determined by the length of period between checks. The person in charge of the tool stores makes it part of his regular duties to inspect all cards in the red box at least once a week, those in the blue box once every two weeks, and so forth, to ensure that the gauges are withdrawn from service and passed along to the checking department at the required times.

Should he discover that a gauge is demanding more frequent overhaul than that specified on its history card, after a very short period he would isolate this card into a separate box for special consideration at an early date. Thus stubborn or flagrant instances of a faulty gauge, etc., would be speedily illuminated and brought to the attention of the responsible person, viz., the tool designer or production moulder. The records on the history cards would then be studied analytically in conjunction with an examination of the gauge and the circumstances in which it is employed, in an endeavour to ascertain the reason for the too frequently repeated defects or errors.

This is an extremely useful scheme, and is one capable of being easily and inexpensively operated by the small as well as the large moulding shop. Whilst it is primarily intended for large works employing a great number of gauges, it should be borne in mind that it is equally important to keep all gauges, irrespective of their number or variety, in sound and accurate condition if quality control inspection is to be consistent and successfully applied. This scheme takes care of all the essential points in gauge control, and will amply repay the small amount of organization required to install it into moulding shop activities.

General Suggestions for Applying Quality Control

The applications of quality control inspection methods are now fairly widespread throughout general engineering, chiefly those processes embracing purely machined productions on such machines as lathes, automatic screw cutting, power presses, drills and the like. Application to plastic moulding operations is, however, somewhat meagre at present, due to the reasons advanced in an earlier section in this series. It is certain that as the need for improved quality in the finished moulded product becomes more stringent, wider use of this method of component inspection will have to be made. Therefore the following general suggestions surrounding the introduction of quality control inspection methods to plastic moulding will prove helpful.

As previously explained, the number of variable factors arising in almost every kind of plastic moulding practice is far greater than that which obtains with purely machined work of the kind just mentioned. This means that the snags encountered and the objections to be overcome will be more numerous and that greater care must be taken, particularly when inaugurating this form of inspection. The following hints are offered as additional guidance to those wishing to install this type of inspection, since they are directed towards avoiding or overcoming just those preliminary troubles.

(1) In the first place introduce quality control methods very gradually. Allow

ample time for experimenting and adapting existing inspection procedures to suit the needs of the new system. Standard types of control charts may sometimes be employed without modification, but generally with most plastic moulding operations some alterations and adaptations will be required to meet the peculiarities of the operations.

(2) Introduce quality control inspection upon a production where the component possesses only one dimension or important feature to be held within fine limits of variation. Do not attempt at the first try-out of such a scheme to control a component having numerous dimensions, all of which are finely toleranced. This entails somewhat complicated charting and considerable experience in their compilation.

(3) Before launching the scheme make sure that the inspection personnel required to operate it on the shop floor are fully conversant with the objectives sought, the methods to be employed, and the underlying reasons for those methods.

(4) Do not attempt to install this form of inspection on very small batch productions. The results may be unreliable and disappointing, due to the inability to obtain adequate data upon which the control charts can be founded. The exception to this will be those cases where the component quantities are known to repeat at frequent intervals.

(5) Before commencing to take samples from a production run which will be needed for the determination of the control chart values, first make sure that every phase and feature involved in the production operation is efficiently planned. This means that most careful attention will have to be devoted to the question of moulds, their method of use, moulding presses, and the degree of accuracy or precision with which they can be worked, the simplicity of all auxiliary loading and unloading facilities, and so on. This is essential because failure to ensure such initial efficiency may result in a subsequent overhauling of the whole procedure to improve production, which would have the effect of upsetting the value of any control charts in use. New charts would then have to be worked out.

(6) When taking samples to determine the mean values for chart construction purposes, remember that it is more preferable to select sample sets of a small number of individual components, taken at very frequent intervals, than to take large sample sets at infrequent intervals. The reasons for this are: (a) in the first case, the time between taking samples is relatively shorter, thereby reducing the likelihood of the moulded product varying or passing out of control, and (b) more reliable and sensitive results will be possible since a greater proportion of variations will be covered.

(7) When taking samples during production, ensure that the length of the sampling period is of sufficient duration to provide a true indication of the normal vagaries of the production run. This is especially important in plastic moulding processes where the number of variations from unassignable causes is likely to be great.

(8) Make provision for recording all relevant data, ascertained both during the trials of the new mould and later during the sampling periods. Much of this information will afford useful future guidance as to the accuracy and suitability of the mould and gauging equipment, etc.

(9) Do not imagine that quality control procedure can be introduced and successfully maintained purely on the basis of theoretical knowledge of the statistical basis of the system. This means that the bringing-in of a trained statistician having no knowledge of plastic moulding may be unwise at the early stages. There must be thorough understanding of, and wide practical experience in, the moulding techniques coupled with a knowledge of quality control before a successful application can be made.

(10) Make proper provisions for keeping all control charts and other records

so that they may be readily deciphered, clean, and compiled in a proper manner and interpreted.

(11) Remember that the introduction of quality control inspection procedure, however simple it may be, will tend to stabilize production, and to reduce errors or defectives, and production shut-downs. This will mean that gradually, as experience is gathered more elaborate forms of control can be introduced and applied with success.

(12) Bear in mind also that a more regularized maintenance attention to the moulding tools and kindred plant will be required. This aspect of works activity will therefore have to be given a similar amount of attention.

(13) Should a mould be drastically modified after some usage, make a complete check-up on the reliability of the control charts when production is recommenced. It often happens that even a very simple and apparently minor readjustment will alter the speed of production, or the accuracy of the finished products, which may cause the control chart to be out of line with the new operating conditions.

(14) Acquire the habit of referring to the accumulated quality control records obtained on previous jobs. The designer will often derive considerable guidance from this information when designing new moulds, gauging equipment, or determining operating methods.

(15) Always give very careful thought to the selection of gauges. Do not imagine that successful quality control results can be obtained by using inadequate or unsuitable gauges. When the moulded component has to be closely controlled on some dimensions try to provide direct reading measuring instruments or gauges whose use does not depend on the "feel" of an operator, or the result of some calculations to be performed by him from other measurements taken. This is very important, and has been more fully discussed earlier in this series.

(16) If during a production run a large number of unit samples issue from a mould and are found to be faulty in some respect, do not expect quality control to bring them miraculously back within the tolerances. This is not the function of the system. Where such a condition arises something will have gone amiss with the charting, or the taking of samples, or in the recording of the values obtained from such samples. A thorough check-up of the whole inspection procedure will be required.

(17) See that proper and authentic provisions are made for enabling an inspector to stop any production run immediately he observes that quality is passing out of control. There must be no arguments about questions of authority and procedure. This should be vested in the inspector. Steps should also be taken to ensure that once a faulty production operation has been detected and stopped, immediate examination of the mould and associated apparatus is carried out to discover the cause of the fault.

(18) Organize the issue, use, and care of all gauging equipment, to avoid use of gauges which are worn and erroneous.

(19) Adopt a standard form of chart plotting throughout the moulding shop and employed by every floor inspector. Likewise, so far as practicable, employ control charts of uniform size and layout.

These are some of the chief points which will arise for consideration when contemplating the introduction of quality control inspection in the moulding shop. If careful attention is afforded these matters there is no reason why a very successful application of the scheme should not result.

(To be continued.)

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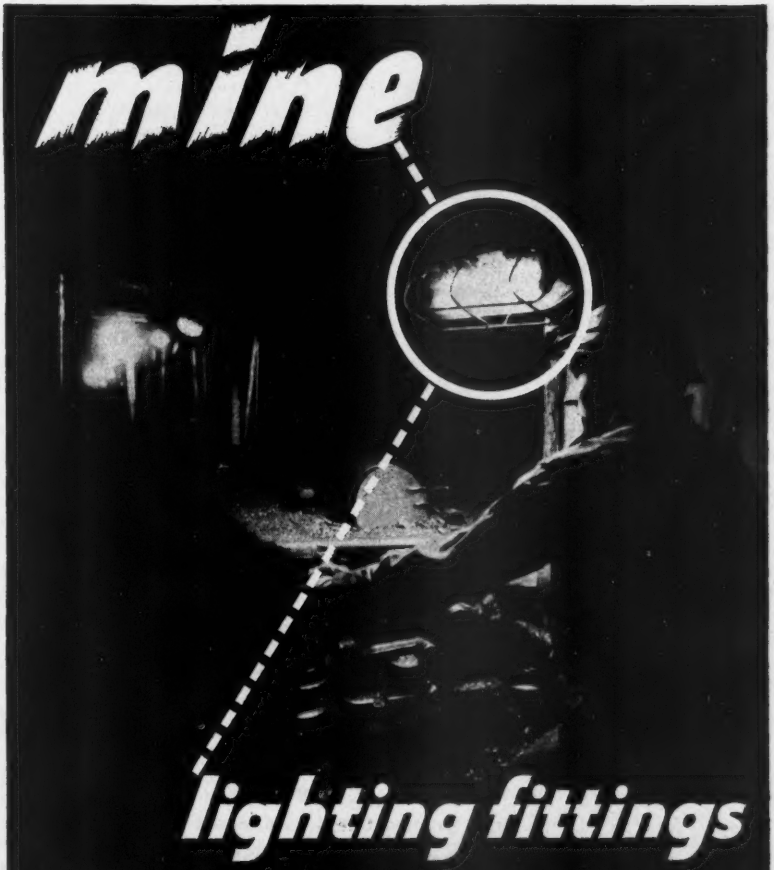

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The Microscopic Examination of Plastic Materials

VII.—Mouldings (Contd.)

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

THE manner in which the secondary particles in the wood flour moulding retain their individuality to a great extent has been demonstrated (" Plastics," December, 1948). Retention of shape is confirmed by the appearances presented by the sharply defined edges to the pigmented portions in the powder, which, in turn, indicate that no fusion of the secondary particles and the impregnated matrix appears to exist, as otherwise the boundaries would not be so sharply defined. This condition was seen to be present even in the case of particles at or near the surface of the moulding, where one would least expect this condition to occur, owing to the more rapid heating of the material which takes place in this position, and in spite of evidence indicating that a higher degree of fluidity had been present in particles thus situated, the boundaries were clearly defined.

As pointed out at the time, however, this was not an indication that no cases of fusion of the two types of material existed, and although such instances are rare, they do exist.

One such case is illustrated in Fig. 361, this being another portion of the same section hitherto considered, photographed at 26 diameters. Here the field illustrates a right-angled corner of the moulding in transverse section. One fairly large secondary particle A, situated in the corner, exhibits the characteristic signs of having flowed to some considerable extent. In these circumstances it will be appreciated that, owing to the greater area of the secondary particle being in contact with the hot mould surfaces, the heating of the mass is very much more thorough and, consequently, flow will be greater. In this case the outline of the particle, although indicated by the dotted line B, is considerably less sharply defined than in those cases previously examined, thus indicating that a certain amount of fusion between pigmented and unpigmented material has occurred.

In order that this may be clarified, the boundary of the unpigmented matrix is indicated by the dotted line C. This has been placed somewhat farther back from its correct position in order that the fusion zone may be easily distinguished. This latter, of course, lies between the two dotted lines B and C. It will be seen that the fusion extends to a fair depth in the secondary particle and is indicated more by an alteration in depth of tone

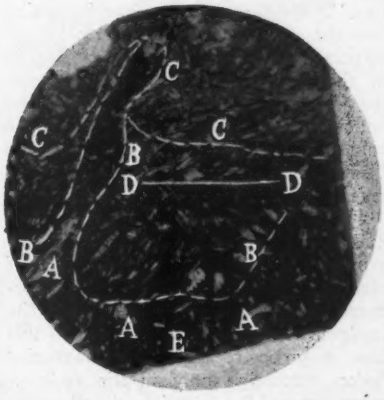

Fig. 361.—Wood flour filled moulding: transverse section. Mag. 26 diameters.

than by any mingling of the primary particles present in both materials. This results in the fusion zone appearing between matrix and secondary particles.

The primary particles in these latter show very little sign of a mingling together, and, indeed, the orientation of the wood particles at the line of contact is the only indication whereby it is possible to establish the existence of a boundary to the secondary particle. This occurs most clearly at the line DD, where the primary particles on both sides are seen to exhibit the type of positioning which might be expected to occur in the event of the two masses being forced together while in a plastic condition. Thus, the primary particles would tend to build up a compact wall at this point, which might be expected to become more so under certain conditions.

At the same time the resin, being in a more fluid condition than generally found elsewhere in this structure, would not be prevented from diffusing either side of the barrier to any great extent, and as the pigment is carried by the resin it should have the effect of indicating its passage by an alteration in tone. In this instance, however, the matrix material shows no great alteration in tone, whereas the structure of the secondary particle has undergone a "lightening" in tone in the fusion zone, thus indicating that the structure at this point has been subjected to penetration by the clear resin of the matrix material passing through the barrier of primary particles. The net result of this has been to lower the concentration of the pigment in the fusion zone and so produce a lighter tone.

This point is interesting inasmuch as it affords further evidence to a previously expressed theory that the presence of pigment in the secondary particles produced a less-fluid material than the unpigmented. Thus, the fusions in this case may be regarded as a selective fusion, occurring only in the resinous component of the materials, the direction being differentiated by the position of the two bodies.

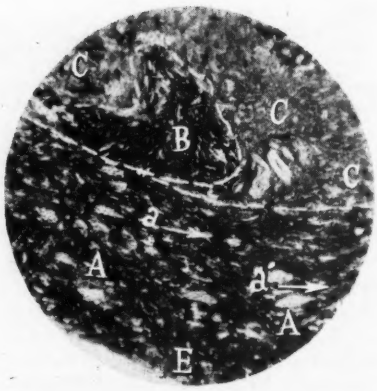

Fig. 362.—Wood flour filled moulding: transverse section. Mag. 26 diameters.

The flow patterns present in the structure of the secondary particle are again seen to be typical; thus the development of narrow extended process has led to a tendency for the filler particles to be carried in a stream towards a point of low pressure, which, however, ceased to exist soon afterwards, resulting in the arrest of the development of the process. The manner in which the particles all tend to point towards the base of the process is an indication of this condition occurring.

The general structure of the moulding in this corner is also of interest, as the flow effects in the powder as a whole are well seen. If we examine the structure a little farther along the edge E, some interesting conclusions may be arrived at as a result of studying the effects produced. Fig. 362 shows the edge E somewhat farther along, but at the same magnification of 26 diameters.

From this illustration it immediately becomes apparent that the secondary particle dealt with in the preceding illustration, is a very large unit the remaining portion of which is seen at A. This particle will be seen to be lying at the surface of the moulding and its structure indicates that it has been subjected to considerable flow in the direction of the

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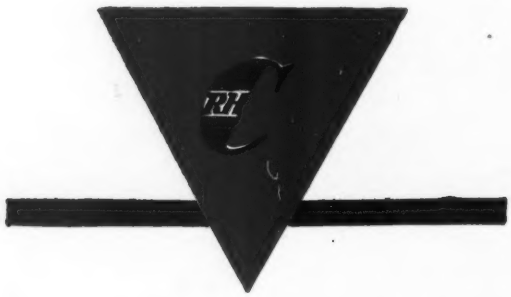

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arrows, a, a. This flow gives all the appearance of having been much greater than that usually encountered with secondary particles. In view of this it is clear that there must have existed a larger difference in pressure between the portion of the secondary particles shown in this illustration (Fig. 362) and that in the preceding one (Fig. 361). This would point to the existence of a space in the corner of the mould being rapidly occupied by the flow of this secondary particle, and which in these circumstances would be more than usually fluid. However, when it met the advancing matrix material a halt occurred, as shown, by an equalizing of the pressure.

The smaller secondary particle B, seen in Fig. 362, is a separate entity which has behaved in a more normal manner; i.e., it shows about the same degree of morphological distortion and boundaries clearly defined, as was seen in the previously examined particles.

The matrix material is seen at C, together with signs of diffusion at the interface of C and A. The diffusion at this point is not so marked as in the previously examined portion of the particle, which fact might be due to there being less movement at the interface at this point than would exist at the point seen in Fig. 361. If this be the case it would seem that the degree of diffusion, if any, is influenced to a certain extent by the relative degree of movement present at the time of the two materials coming into contact with one another. That this movement must have been fairly considerable is shown by the turbulence under the line DD (Fig. 361), indicated by the orientation of the filler particles.

Up to the present we have examined the effects produced by a mixed moulding powder containing pigmented and unpigmented fractions and the behaviour of the two portions has been studied in a general manner. The examination was carried out under low magnification and it is now proposed to look somewhat closer at the structure of this moulding at increased magnification. The first subject

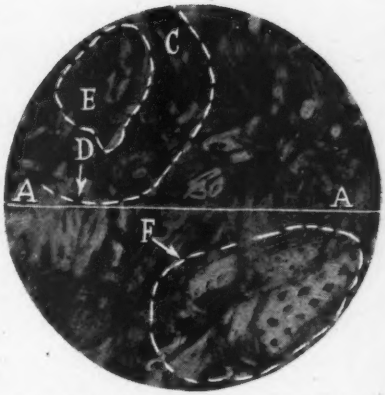


Fig. 363.—Wood flour filled moulding. Mag. 190 diameters.

which would appear to offer interesting possibilities is the minute structure of the pigmented secondary granules.

As a commencement, Fig. 363 illustrates a portion of one such area in the section, at 190 diameters. Under low magnifications these areas appeared to be fairly even, insofar as the distribution of the pigment is concerned, but an initial examination of this illustration shows that this characteristic requires further discussion, as the pigment is seen to be distinctly "patchy." Thus the area in the field may be roughly bisected by the line AA, showing a denser pigmentation in the upper half, which in itself is seen to be more densely pigmented on the left-hand side in the area B. The concentration of pigment in this area is also seen to be uneven. This effect is produced by the presence of numerous large wood particles, such as those at C and D. In fact, wherever a wood particle appears, so also does a light area, due to the cellulose being unaffected by the pigment and in consequence thereof being very much more transparent than the pigment; hence it is necessary when studying the disposition of pigment under high powers to bear this in mind.

In the case of the area under examination, the pigment is seen to be concentrated between the larger wood particles,

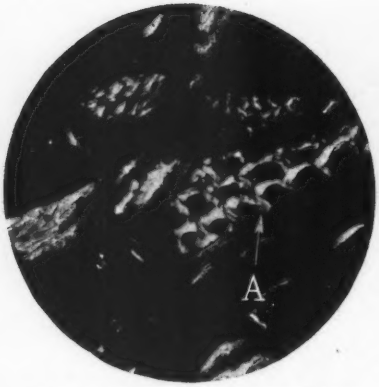


Fig. 364.—Wood flour filled moulding as seen under polarized light. Mag. 190 diameters.

Fig. 365.—Wood flour filled moulding showing numerous wood particles. Mag. 91 diameters.

a typical example of which occurs within the area E, which is seen to contain the large particle C, and another not quite so large; near this latter are seen two or three fairly large and very dense agglomerates of pigment occurring between the wood particles.

That portion of this area which is not so dense consists of a mixture of pigment and fine wood particles amounting almost to dust. The interesting feature of the appearance of this portion of a secondary particle, under these conditions, is the impression so given of portions of pigmented material surrounded by matrix substance, itself unpigmented; in other words, by increasing the magnification we make visible a structure within the boundaries of a secondary particle, which is similar in appearance to the general structure of the moulding as seen under low powers and containing the clearly defined secondary particles.

Further evidence of the agglomeration of pigment is seen in the lower group marked F, consisting of a number of large wood particles situated close together; the agglomeration can clearly be seen to occur in spaces between these particles.

The structure of these particles is interesting, inasmuch as they afford a valuable means of identifying the filler, whereas in general it is quite clear that this latter is wood; the species of wood is clearly indicated by the structure of the particles, and indicates the presence of soft wood. If there is any doubt on this subject, clarification may be obtained by resorting to the use of polarized light and higher magnification (190 diameters), as seen in Fig. 364. Under these conditions the wood is much more clearly seen to exhibit the typical softwood cell structure.

The effect of this open structure in avoiding collapse of the cells is also very well shown, as these latter are seen to have suffered practically no crushing, such as that experienced by closed thin-walled structures met with in other types of fillers. It also follows that, in these instances, impregnation of the structure with resin must occur to a high degree, as otherwise it would show signs of collapse. This is best illustrated in the case of the particle marked A. The material surrounding the group of particles can be seen to contain numbers of much smaller wood units, some of which are, however, practically obscured by the masses of pigment which do not polarize and are opaque.

These particles, however, are a few isolated examples of softwood which are capable of identification without a great

deal of doubt, and before one can be certain as to the nature of the filler in general, it is necessary to thoroughly examine the section and establish the fact that there exists a large number of particles which may be identified.

In proceeding with this examination we may pick out typical fields, such as that shown in Fig. 365, where the structure of numerous wood particles is clearly visible. Thus the particles marked A, B and C, present typical softwood structure, as seen in transverse section. The vessels appear to have suffered very little crushing during the moulding process, and, in fact, are in an excellent state of preservation, so much so that even at this magnification the structure of the cell walls is fully visible.

In contradistinction to this, the particle marked D, and also those in its immediate vicinity within the area shown, have suffered considerably from the effects of pressure, as has been previously pointed out. This is due mainly to the existence of a difference of pressure occurring between the surrounding resin mass and the internal cavities of the cells, leading to the collapse of these latter before the resin has had time to penetrate and fill the cells, thus levelling the pressure.

It would, therefore, seem probable that during the moulding process, conditions became operative, so that penetration of the resin was prevented. The exact cause of this is a matter for conjecture, but one cannot avoid attaching a certain amount of significance to the presence of relatively large agglomerates of pigment around and between the particles in question, particularly around that marked D. This leads to the assumption that the pigment might in certain circumstances result in blocking the entry of the resin into the structure of the filler particles, thus allowing the development of conditions leading to the collapse of the structure. It may, therefore, be concluded that so far as penetration of resin into the filler is concerned, the homogeneity of the moulding is likely to be somewhat variable, depending on the local concentration of pigment and whether agglomeration of this latter is profuse or not.

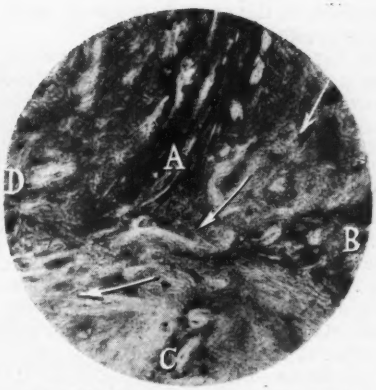


Fig. 366.—Wood flour filled moulding showing secondary particles in unpigmented material. Mag. 91 diameters.

Fig. 365 is again a portion of the section within the boundaries of a secondary particle, and once again the variable distribution of the pigment is to be noted, together with the presence of numerous agglomerates which appear to occur in no particular pattern, with perhaps the possible exception of localities, such as that in the neighbourhood of particle D.

The question of the behaviour of the pigment is of interest from the point of view of the causes leading to agglomeration. Assuming that the dispersion is even, from the mechanical aspect, it would appear that the agglomeration is electrical in nature, due to dissimilar charges existing in the mix. This problem is well known in the paint industry and it seems probable that similar conditions apply in the compounding and mixing of moulding powders. However, the exact causes are somewhat obscure in this case and must remain so until such time as they can be elucidated and brought under control. In the meantime, there is little doubt that the phenomenon exists, and much can be done to rectify this by a careful choice of pigment. We

shall discuss this question in greater detail subsequently.

It has been shown how the particles of the pigmented fraction of the moulding powder behave in some respects as though they were particles of a coarse filler, although subject to considerable morphological modification, due to their plasticity under the conditions encountered during the moulding cycle. They retain sufficient of their individuality to clearly indicate their behaviour as such. In view of this, it is of interest to examine the problem from the point of view of the ultimate effects produced on the unpigmented matrix by the secondary particles.

As the majority of these units are far too large to study as complete entities, the most satisfactory method to employ is to search the section for a relatively large area of unpigmented material containing a few small secondary particles, more or less isolated. One such portion, illustrated in Fig. 366 at 91 diameters, shows three small secondary particles in a mass of unpigmented material. The particles are annoted A, B and C in the margin of the photograph, and to the left of particle A the edge of a large secondary particle is just visible. At the outset it is fairly clear that these three particles have had a not inconsiderable effect upon the flow pattern of the matrix.

Bearing in mind that the secondary particles in question are situated in the middle of the moulding, that is, well away from the mould faces, it is reasonable to suppose that they would remain less fluid than those situated at the edge for an appreciably longer period of time, in which case they would be less plastic, and in consequence they offer greater resistance to the distorting forces. As a result of this, it will be seen from the illustration that the matrix material has well-developed flow patterns, particularly in the channel formed between particles A and B, the flow in this case taking place in the direction shown by the arrows between them.

An interesting situation appears to have developed at the point D, where the

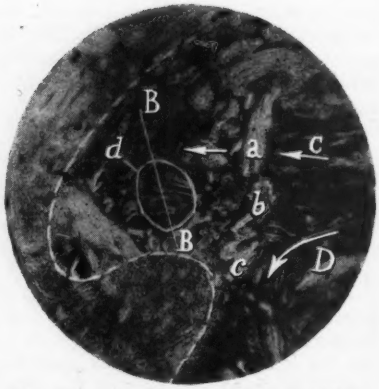
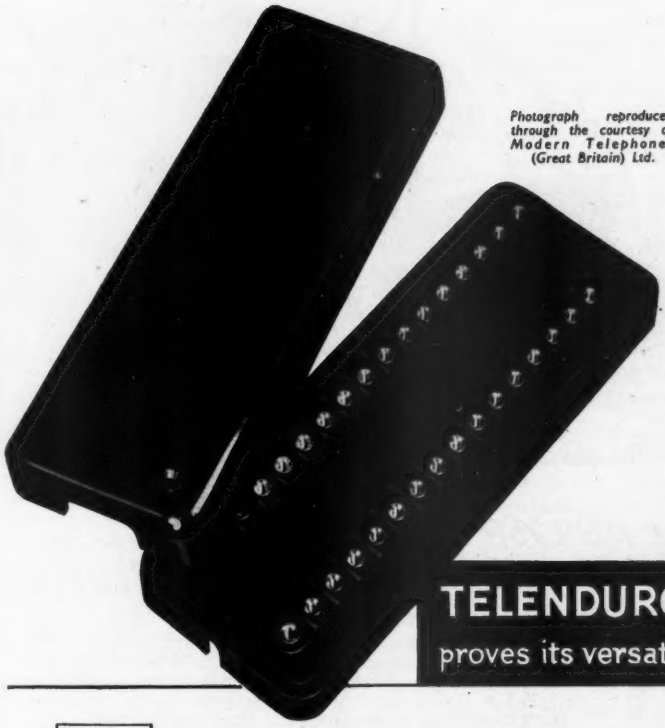


Fig. 367.—Wood flour filled moulding showing outer fringe of secondary particle. Mag. 91 diameters.

flow of the matrix material has been redirected or arrested by the presence of a similar mass to the left of particle A. Thus, it is probable that the lower extended process on the left of the lower end of this particle was formed under the joint influence of the flowing of the two masses of matrix material on either side of particle A. Similar flow patterns are seen to exist in the matrix in the vicinity of particles B and C.

The development of these extended processes may be expected to somewhat modify the pigment distribution in the secondary particles, more particularly where a large amount of agglomeration is present. Thus, for example, it can be imagined how a process in the course of being projected through a relatively narrow neck or channel would be liable to have less pigment in the mass beyond than in a position immediately prior to the entry of the channel. Thus, the pigment granules and agglomerates beyond the construction would be more scattered and fewer in number per unit volume.

In practice this phenomenon does occur, but not to the marked extent which might be expected. It is more marked in occurrence on a smaller scale within the actual structure of the



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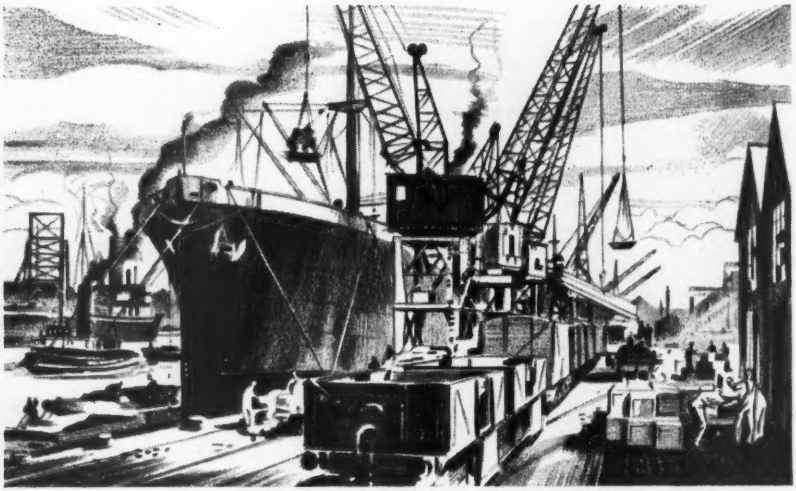

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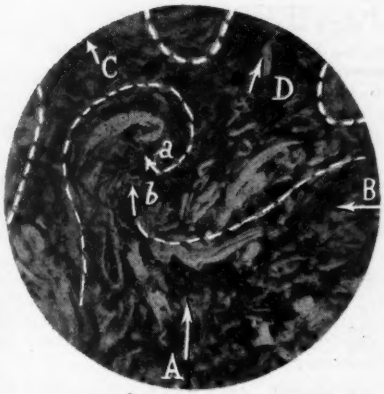

Fig. 368.—Bakelite moulding, wood filled, showing relatively large secondary particle. Mag. 91 diameters.

secondary particle, due to the formation of obstructions and channels developed by the orientation of the wood particles in the unpigmented material, which must inevitably occur. The occurrence of this may be seen in Fig. 367, which shows portion of the outer fringe of a secondary particle near the surface of the moulding at a magnification of 91 diameters. For clarity, the boundary of the secondary particle A is marked with a dotted line. In the structure of the secondary particle at this point, it will be noted that there exists a high concentration of pigment to the right of the illustration, while on the left of the line formed by wood particles a, b, and c, the concentration of pigment is decreased.

It is clear from the orientation of these particles of wood flour that a barrier to any further progress was laid down, in consequence of which an alteration in the direction of flow of the main mass of the secondary particle occurred, as indicated by the arrows at C and D. Flow of the material continued on the other side of the barrier in the direction shown by the arrow at a, until another barrier of sorts developed along the line BB by orientation of filler particles of the nature of that shown in the area d, and to the left of which a further reduction in pigment concentration occurs.

Further study of this microphotograph shows the existence of another filler particle barrier above C, and the possibility of the presence of a further example below D. It will be noticed that the barriers in question are formed by the orientation of large wood particles. Those nearest the centre of the secondary particle contain the largest wood flour units, while the barrier BB is composed of wood particles which are smaller than those in any of the other barriers. Thus, as may be expected, with the movement of the material taking place in the direction indicated, the units of which the barriers are composed become progressively smaller. It is also interesting to speculate the result which would be produced by a wood flour containing units of the same size.

It has previously been pointed out that the secondary particles in this moulding exhibit internal structures characterized by wood-filled mouldings in general, that is, they behave as little mouldings in themselves. This is most easily recognized by a study of the behaviour of the wood particles making up the filler, as evidenced by the example in Fig. 368, which shows a portion of a relatively large secondary particle at a magnification of 91 diameters.

It would appear from the structure seen that, in the first instance, flow of the material occurred in the two directions shown at A and B. Differences in pressure resulting in the development of two extended processes, the roots of which are seen at C and D (their direction being also indicated when flow in these processes ceased), the mass in the centre would still be fluid. Further, as pressures in directions A and B are still operative, assuming a slight difference in pressure still existing in the centre, the turbulence indicated at "a" and "b" would develop. This phenomenon is clearly indicated and is typical of similar cases occurring at or near the surface of mouldings made with one powder only.

(To be continued)

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2. price 1/- each.

B.P. 606,702. Appl. 23.1.46. Conv. (Netherlands) 12.7.44. Acc. 18.8.48.

Stabilization of Organic Substances of High Molecular Weight containing Combined Halogen. To: N.V. De Bataafsche Petroleum Maatschappij.

Stabilization of p.v.c., etc., with metal soaps of wool fat acids (lead, silver or mercury soaps).

B.P. 606,705. Appl. 11.2.46. Acc. 18.8.48.

Manufacture of Highly Polished Polyvinyl Chloride Sheets and Coated Fabrics. W. L. Brogan. To: Imperial Chemical Industries, Ltd.

Refers to the use of a film of regenerated cellulose which is interposed between the hot rollers of the calender and the p.v.c. sheet, preventing the p.v.c. from sticking to the hot metal.

B.P. 606,716. Appl. 2.1.46. Acc. 19.8.48.

New Polymerizable Materials and Polymers thereof. R. Hammond. To: Imperial Chemical Industries, Ltd.

Production of new polymers containing two vinyl groups per molecule by reacting a dihydric alcohol with one or more chloroformates of half esters of dihydric alcohols and acrylic, methacrylic or an alpha-haloacrylic acid.

B.P. 606,807. Appl. 16.5.45. Conv. (U.S.A.) 20.6.44. Acc. 20.8.48.

Production of Synthetic Elastomers. E. T. Bishop. To: Shell Development Co.

Refers to the copolymerization of branch chain 1.3-hexadienes with 1.3-dienes of 4 and 5 carbon atoms.

B.P. 606,817. Appl. 7.12.45. Acc. 20.8.48.

Moulded Plastic Radio Receiver Cabinets. F. E. Middleditch and S. R. Hawkins. To: De La Rue Plastics, Ltd.

B.P. 606,879. Appl. 3.11.43. Acc. 23.8.48.

Plasticizing Apparatus for the Moulding of Plastics. F. Youle. To: Communications Patents, Ltd.

Refers to high-frequency heating equipment incorporated in the extrusion head of an extruding machine or in the die system of an injection moulding machine.

B.P. 606,880. Appl. 7.7.44. Conv. (U.S.A.) 25.5.43. Acc. 23.8.48.

Fabrication of Extruded Thermoplastic Articles. C. E. Slaughter

B.P. 606,936. Appl. 22.1.46. Acc. 23.8.48.

Moulding Polyvinyl Chloride Pastes. J. A. Hetherington. To: BX Plastics, Ltd.

Manufacture of rigid or semi-rigid p.v.c. mouldings by using a paste which prior to moulding is intimately mixed with a liquid monomer (methyl methacrylate). Moulding is carried out under conditions which enable the paste to gelatinize and allow the monomer to polymerize.

B.P. 606,963. Appl. 23.5.45. Conv. (U.S.A.) 25.5.44. Acc. 24.8.48.

Shrinkable Container Closure and Process of Making the Same. To: Sylvania Industrial Corporation.

Container closure produced by forming a thermoplastic tubing, comprising a thermosetting material in the thermoplastic state, stretching the tubing transversely, severing the tubing transversely into bands, applying at least one band to a container, subsequently applying heat to cause shrinkage.

B.P. 606,980. Appl. 19.12.45. Conv. (U.S.A.) 2.10.45. Acc. 24.8.48.

Butadiene-styrene Copolymer. To: Wingfoot Corporation.

B.P. 607,022. Appl. 1.5.46. Conv. (U.S.A.) 1.5.45. Acc. 24.8.48.

Polysiloxane Resin Enamels. To: The British Thomson-Houston Co., Ltd.

B.P. 607,031. Appl. 4.6.46. Acc. 24.8.48.

Manufacture of Resinous Condensation Products. E. A. Bevan and R. S. Robinson. To: Beck, Koller and Co. (England), Ltd.

B.P. 607,035. Appl. 23.1.46. Acc. 25.8.48.

Textile Fibres or Yarns of Glass and Textile Materials formed therefrom. S. A. Hartman.

Coating of glass fibres or textiles produced therefrom after etching of the glass surface with a solution of weak caustic soda to improve subsequent bonding.

B.P. 607,072. Appl. 24.1.46. Acc. 25.8.48.

Raincoats and like Articles of Wearing Apparel. M. L. McCulloch. To: Sportapools, Ltd.

Plastic raincoats and the like produced by a technique combining stitching and welding.

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B.P. 607,104. Appl. 25.1.46. Acc. 25.8.48. Phenol Formaldehyde Condensation Resins. T. J. B. Arthur. To: Imperial Chemical Industries, Ltd.

B.P. 607,151. Appl. 28.1.46. Acc. 26.8.48. Production of Artificial Flowers. L. Rado.

Refers to artificial flowers made from p.v.c. sheeting.

B.P. 607,329. Appl. 30.1.46. Conv. (U.S.A.) 30.1.45. Acc. 30.8.48. Treatment of Polymeric Methyl Methacrylate. To: Imperial Chemical Industries, Ltd.

Modified polymethyl methacrylate prepared by reacting at elevated temperature a suspension of finely divided polymethyl methacrylate with stearyl mercaptan or mecapto-ethanol.

B.P. 607,426. Appl. 4.2.46. Conv. (U.S.A.) 10.2.45. Acc. 31.8.48. Alkylsilicone Sols and Gels. To: British Thomson-Houston Co., Ltd.

B.P. 607,427. Appl. 4.2.46. Conv. (U.S.A.) 10.2.45. Acc. 31.8.48. Organo-silico Sols and Gels. To: British Thomson-Houston Co., Ltd.

B.P. 607,463. Appl. 5.2.46. Acc. 31.8.48. Joining and Cutting Thermoplastic Material. L. Rado.

Refers to the cutting of high-frequency welded thermoplastic article. Cutting is carried out whilst the welded area is still under pressure.

B.P. 607,499. Appl. 6.2.46. Conv. (U.S.A.) 13.2.45. Acc. 1.9.48. Methods of Producing Vinyl Fluoride Polymers. To: British Thomson-Houston Co., Ltd.

B.P. 607,546. Appl. 7.2.46. Acc. 1.9.48. Flexible Pressure Sensitive Packaging Material. E. F. Hall. To: Transparent Paper, Ltd.

Pressure sensitive adhesive tape comprising a backing material (regenerated cellulose) coated on one side with an adhesive composition consisting of 100 parts of polystyrene and 70 to 175 parts of a plasticizer compatible with polystyrene (alpha-methylstyrene).

B.P. 607,572. Appl. 8.2.46. Acc. 1.9.48. Improved Apparatus for Heating Materials by Means of High-frequency Electric Currents. J. H. Suker. To: British Insulated Callenders Cables, Ltd.

Apparatus for preheating moulding powders, etc., by high-frequency energy.

B.P. 607,635. Appl. 6.2.46. Conv. (U.S.A.) 7.2.45. Acc. 2.9.48. Heat-hardenable Phenolic Resins. To: Bakelite, Ltd.

Manufacture of alkali resistant heat-hardenable phenol-formaldehyde resins by preparing of a phenol-formaldehyde resin, etherifying it so that at least 50 per cent. of the aryl-hydroxy groups are etherified and adding an acid catalyst to the etherified resin.

B.P. 607,641. Appl. 9.2.46. Acc. 2.9.48. Construction of Contact Lenses for the Eye. A. J. Forknall.

B.P. 607,690. Appl. 18.5.45. Acc. 3.9.48. Process for Heating Compositions by High - frequency Alternating Electric Currents. P. H. Amphlett. To: Dunlop Rubber Co., Ltd.

Heat treatment of rubber and synthetic resins by heating them at a predetermined temperature with a high-frequency current. Refers particularly to rubber or resin mixtures containing polar materials (alpha-nitronaphthalene, dimethyol nitroethanes, p-nitroaniline, m-nitroaniline, p-nitrophenol or m-dinitrobenzene.

B.P. 607,693. Appl. 13.6.45. Acc. 3.9.48. Process and Apparatus for Transfer Coating. To: Sylvan Industrial Corporation.

B.P. 607,704. Appl. 12.10.45. Acc. 3.9.48. Production of Emulsions of Polymerized Esters of Acrylic and Methacrylic Acids. J. E. O. Mayne, H. Reichard and H. Warson. To: Vinyl Products, Ltd.

B.P. 607,735. Appl. 11.2.46. Conv. (U.S.A.) 9.2.45. Acc. 3.9.48. Polymerization of Monoethylenic Compounds. To: E. I. Du Pont de Nemours and Co.

B.P. 607,755. Appl. 11.2.46. Conv. (Netherlands) 16.6.44. Acc. 3.9.48. Manufacture of Moulded Synthetic Resin Articles. To: N.V. De Bataafsche Petroleum Maatschappij.

Manufacture of moulded articles from polymethyl methacrylate or methyl methacrylate-vinylidene halide copolymer.

B.P. 607,756. Appl. 11.2.46. Conv. (Netherlands) 30.9.44. Acc. 3.9.48. Manufacture of Moulded Synthetic Resin Articles. To: N.V. De Bataafsche Petroleum Maatschappij. Similar to B.P. No. 607,755.

B.P. 607,773. Appl. 30.4.45. Acc. 6.9.48. Resinous Compositions. D. N. Davies. To: Cellomold, Ltd.

Resinous cement suitable for cementing glass globes of wireless and like valves to

moulded phenolic bases, consisting of a two-stage phenolic-aldehyde resin, magnesia and inert fillers.

B.P. 607,811. Appl. 12.2.46. Acc. 6.9.48.
Preparation of Organosilicon Compounds. A. G. Taylor. To: Albright and Wilson, Ltd.

B.P. 607,817. Appl. 12.2.46. Acc. 6.9.48.
Device for Perforating Elastic Sheet Material. H. Ewing. To: British Celanese, Ltd.

B.P. 607,828. Appl. 12.2.46. Conv. (U.S.A.) 3.4.45. Acc. 6.9.48.
Plastic Rivets and Method of making Same. To: The United States Rubber Co.

Plastic rivet made from a mixture of rubber and thermoplastic resins which is rigid at moderate temperatures. When heated to a temperature above the softening point of the resin it contracts longitudinally and moves the rivet heads towards each other.

B.P. 607,836. Appl. 12.2.46. Acc. 6.9.48.
Bathing Helmet. N. Marcus and A. Marcus. To: N. and A. Marcus.

Refers to stitched p.v.c. bathing helmets.

B.P. 607,885. Appl. 23.10.45. (Addition to No. 590,167.) Acc. 7.9.48.
Synthetic Resinous Moulding Compositions. J. Allan. To: British Celanese, Ltd.

Moulding composition having a basis of a synthetic resin, comprising unspun staple fibres of regenerated cellulose impregnated with the synthetic resin.

B.P. 607,888. Appl. 7.11.45. Acc. 7.9.48.
New Polymerizable Organic Materials and Polymers thereof. R. Hammond. To: Imperial Chemical Industries, Ltd.

Refers to the polymerization of materials containing two unconjugated $CH_2=C<$ groups per molecule by reacting acrylic acid or an ester-forming derivative thereof with a dihydric polyester or a mixture of dihydric polyesters.

B.P. 607,904. Appl. 13.2.46. Acc. 7.9.48.
Machinery for Cutting out Pieces of Plastic Material from a Continuously Moving Sheet. E. M. Crosland. To: T. and T. Vicars, Ltd.

B.P. 607,911. Appl. 13.2.46. Conv. (U.S.A.) 13.2.45. Acc. 7.9.48
Production of Partially Hydrolysed Vinyl Ester Polymers and Interpolymers. To: E. I. Du Pont de Nemours and Co.

B.P. 607,913. Appl. 13.2.46. Conv. (U.S.A.) 15.3.45. Acc. 7.9.48.
Resinous Bonding or Adhesive Compositions. To: Westinghouse Electric International Co.

Resinous bonding or adhesive composition suitable for the bonding of metal laminations, comprising the partial reaction product of 160 parts of aniline, 533 parts of phenol, 200 parts of paraformaldehyde, 110 parts of 40 per cent. formaldehyde, 520 parts of solvent, combined with a polyvinyl acetate solution.

B.P. 607,995. Appl. 13.2.46. Acc. 8.9.48.
Apparatus for and Method of Forming Hollow Articles from Sheet Material. G. W. Borklands.

Refers to the forming of hollow articles from thermoplastic sheet materials using pressure and suction.

B.P. 608,023. Appl. 27.3.46. Acc. 8.9.48.
Manufacture of Resinous Condensation Products. E. A. Bevan and R. S. Robinson. To: Beck, Koller and Co. (England), Ltd.

B.P. 608,027. Appl. 4.6.46. (Divided out of B.P. 607,408.) Acc. 8.9.48.
Manufacture of Resinous Condensation Products. E. A. Bevan and R. S. Robinson. To: Beck, Koller and Co. (England), Ltd.

B.P. 608,052. Appl. 31.12.45. Conv. (U.S.A.) 1.1.45. Acc. 9.9.48.
Phenol Formaldehyde Resins. To: Westinghouse Electric International Co.

Relates to phenol formaldehyde thermosetting resins and laminates and moulded products made therefrom, having an exceedingly slight odour, prepared from phenol and formaldehyde in proportions of 1 to 1, 25 mols using ethylene diamine as catalyst.

B.P. 608,109. Appl. 15.2.46. Acc. 9.9.48.
Adhesives. E. J. G. Balley, F. M. Page and J. C. McGowan. To: Imperial Chemical Industries, Ltd.

Adhesive composition comprising an amido-formaldehyde condensation product and between 2 and 50 per cent. of di (tetrahydrofurylethyl) carbinol.

B.P. 608,118. Appl. 22.2.46. Conv. (Spain) 12.4.45. Acc. 9.9.48.
Moulds for Manufacture of Hair Combs. F. C. Monnet, R. C. Monnet and R. C. Monnet.

B.P. 608,123. Appl. 10.1.44. Conv. (U.S.A.) 26.12.42. Acc. 10.9.48.
Flexible, Collapsible Fluid Containers and Method of Producing Same.

B.P. 608,332. Appl. 20.2.46. Conv. (U.S.A.) 20.2.45. Acc. 14.9.48.
Elastic Fabrics. To: E. I. Du Pont de Nemours and Co.

Treatment of nylon containing textiles with an aqueous solution containing formaldehyde, an aliphatic alcohol and an oxygen containing acid catalyst.

B.P. 608,333. Appl. 20.2.46. Conv. (U.S.A.) 20.2.45. Acc. 14.9.48.

Production of Cured Ethylene Polymers. To: E. I. Du Pont de Nemours and Co.

Curing of saturated ethylene polymers (interpolymer of ethylene and vinyl acetate) by heating it in the presence of stearic acid and an inorganic peroxy compound in order to reduce the solubility of the polymer in organic solvents.

B.P. 608,334. Appl. 20.2.46. Conv. (U.S.A.) 20.2.45. Acc. 14.9.48.

Production of Coloured Artificial Fibres and the Like from Normally Solid Ethylene Polymers. To: E. I. Du Pont de Nemours and Co.

Colouring of polythene fibres by dispersing dyes or pigments throughout the solid polymer powder and then extruding the mix into fibres.

B.P. 608,335. Appl. 20.2.46. Conv. (U.S.A.) 20.2.45. Acc. 14.9.48.

Improving the Properties of Nylon Fibres. To: E. I. Du Pont de Nemours and Co.

B.P. 608,414. Appl: 22.2.46. Conv. (U.S.A.) 22.2.45. Acc. 15.9.48.

Curing of Polymeric Materials. To: E. I. Du Pont de Nemours and Co.

Curing of chlorinated polythene or polymethyl methacrylate by heating it under pressure in the presence of a peroxy compound. This process can be used for making plywood by uniting the individual plies with the uncured resin and subsequently curing it.

B.P. 608,478. Appl. 25.2.46. Acc. 15.9.48.

Preparation of Anhydrous Normally Liquid Ethers for Use more particularly in the Production of Silicone Intermediates. W. K. Buchanan and W. Simpson. To: Metropolitan-Vickers Electrical Co., Ltd.

B.P. 608,487. Appl. 29.12.43. Conv. (U.S.A.) 31.10.42. Acc. 16.9.48.

Preparation of Colloidal aqueous Dispersions of partially Polymerized Anionic Dimethylol Urea or Dimethylol Urea Ether and Methods of Treating Fibrous Materials with said Dispersions. American Cyanamid Co.

B.P. 608,516. Appl. 25.2.46. Acc. 16.9.48.

Cation-exchange Resins. T. R. E. Kressman and L. E. Holmes. To: The Permutit Co., Ltd.

Quebracho tannin is sulphited with sodium metabisulphite and condensed in alkaline solution with formaldehyde in the presence of hydroxybenzene.

B.P. 608,548. Appl. 26.2.46. Acc. 16.9.48.

Polymerization of Coumarone and Indene. R. Y. Eagers. To: James Wilkinson and Son, Ltd.

B.P. 608,635. Appl. 11.4.46. Acc. 17.9.48.

Polymerization of Vinyl Compounds. B. T. D. Sully. To: A. Boake Roberts and Co., Ltd.

The vinyl compound (monostyrene and homologues) is dispersed in a solution of a water soluble sulphite oxidizable by free oxygen, or in a solution of free sulphur dioxide, and the dispersion subjected to polymerization under non-oxidizing conditions.

B.P. 608,665. Appl. 2.8.45. Acc. 20.9.48.

Hydrocarbon Copolymers. To: Standard Oil Development Co. Refers to styrene-isobutylene copolymers.

B.P. 608,698. Appl. 27.2.46. Acc. 20.9.48.

Manufacture of Highly Polymeric Carbonates. J. W. Batty and H. P. W. Huggill. To: Imperial Chemical Industries, Ltd.

B.P. 608,725. Appl. 28.2.46. Conv. (U.S.A.) 1.3.45. Acc. 20.9.48.

Coloured Fluorescent Materials and Articles To: British Celanese, Ltd.

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B.P. 608,807. Appl. 1.3.46. Conv. (U.S.A.) 1.3.45. Acc. 21.9.48.

Copolymers of Halogenated Ethylenes. To: E. I. Du Pont de Nemours and Co.

LETTERS TO THE EDITOR

(Continued from page 89.)

different materials, phenolic, urea, acrylic, polystyrene, polythene, and so on. There is little to comment on, except perhaps drainage provision and colour. Drainage, that is a few simple holes, should be provided when watering is frequent, since water resistant plastics may provide conditions favouring the development of fungus within the bowl. As for colour, single pastel shades are preferred as the flowers themselves are the main decoration; violent colours for pots would conflict with the delicate flower colours.

As for printing machinery, the following concerns may help: Trapinex, Ltd., 355, High Road, London, N.22; Funditor, Ltd., 2, Woodbridge Street, London, E.C.1; Geo. Mann and Co., Ltd., 356, Grays Inn Road, London; Practical Machines Co., Ltd., 46, Camberwell Green, London; Soldan's, Ltd., 5-11, Theobalds Road, London.]

BOOK REVIEWS

(*Continued from page 60*)

(1) Plastics. (2) Their moulding, forming and working. (3) Economics of the plastics industry. (4) Technical tables.

As an example of the general method adopted, the details in Section 1 are interesting. It is divided into five chapters: (1) The basic resins. (2) Agents, such as solvents, plasticizers, fillers, pigments, catalysts, stabilizers, etc. (3) Semi-finished products, i.e., moulding powders, glues, laminates, expanded plastics, etc. (4) Properties and uses. (5) Tests.

The first chapter on the subject of the basic resins is deserving of special mention for its excellence. It begins with simple definitions and simple diagrammatic descriptions of the methods of formation of polymers and condensates in a manner we have never seen bettered. This is followed by a study of the structures of the resins and of the various methods of determining them by viscosity measurements, the ultramicroscope, the spectrograph and X-rays. The study is completed by a consideration of the relation between structure and properties. This method of careful analysis is continued throughout the book.

All three authors are well-known chemists or engineers, Dr. Dubois being the Director of the Centre d'Etude des Matières Plastiques and Editor of "Industries des Plastiques."

Our praise of this manual may be summed up by the hope that it will one day be translated into English.

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Leaves from a Moulder's Notebook

This is the twenty-sixth in a series of notes by B.I.P. Development Department on the problems of the moulder and designer. Nos. 1-12 in this series are already available in booklet form and a second volume which will include this article is being prepared. Comments and enquiries are welcome.

+or − x°F

In No. 25 of this series was discussed a small job which, for efficient moulding, needed the additional assistance obtained by having the top and bottom tools of the mould at different temperatures. A further example is a moulding having a two bladed insert projecting upwards as shown in Fig. 1; the mould is illustrated in Fig. 2.

In this case flash percolated up the insert slots in the top punches and extraction difficulties followed. A reduction in punch temperature caused some improvement but the complete solution followed only when all heat was taken from the punch plate.

This would not be successful on a mould with a large area of punch in contact with the moulding, as undercuring would result. In the mould illustrated, however, only the extreme end or nose of the punch was exposed to the material; as this part of the punch came in close contact with the cavity of the die it gained from it sufficient heat to produce a properly cured moulding with a cure time only slightly in excess of normal.

Fig. 1

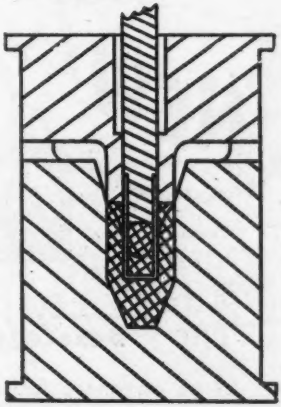

Fig. 2

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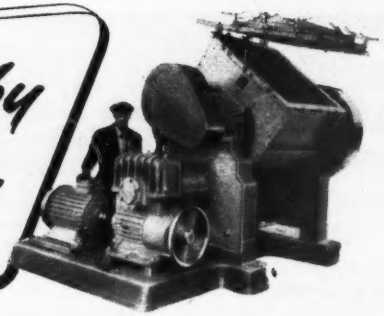

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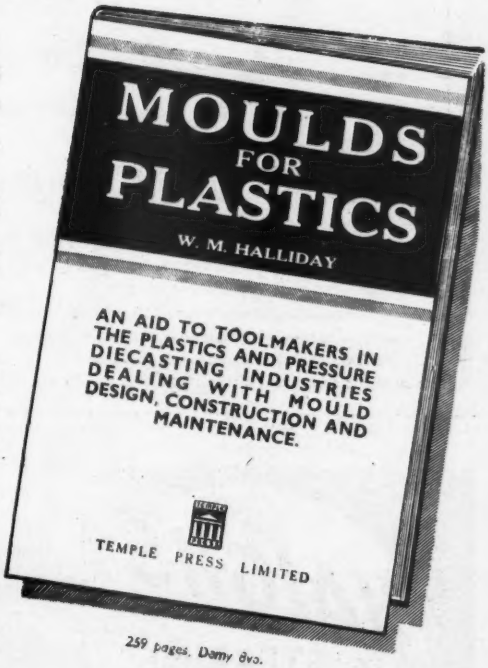
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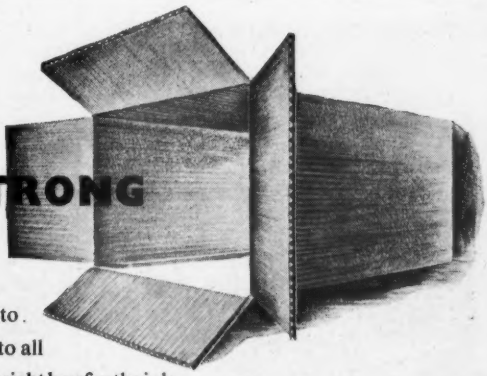

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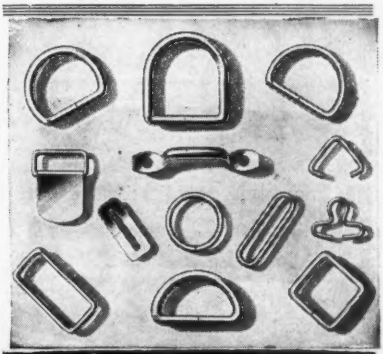

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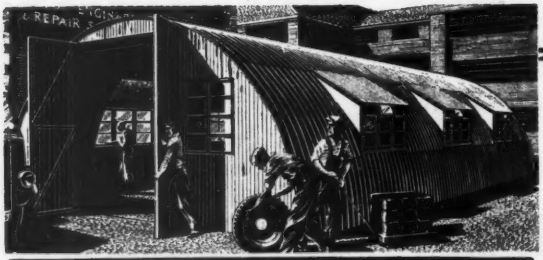

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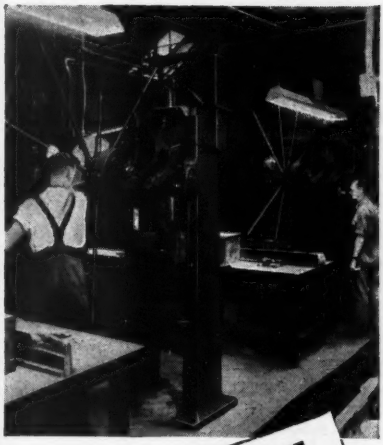

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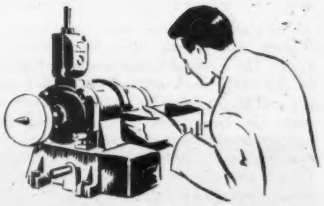

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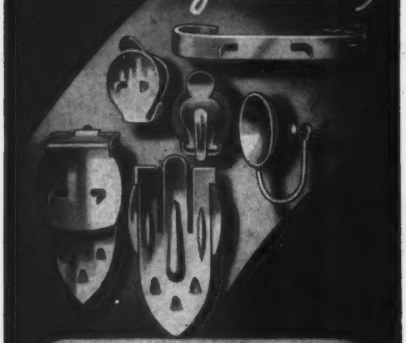

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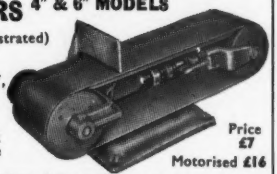

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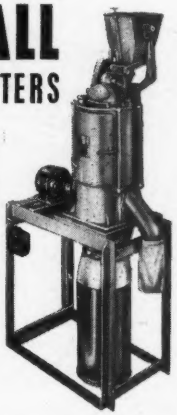

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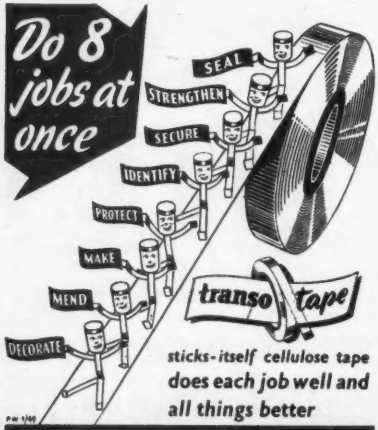

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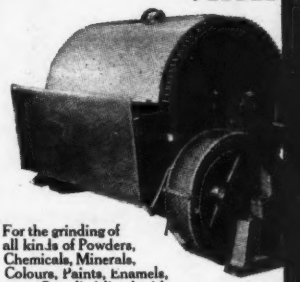

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Wanted. Comb mould for 4-oz. injection moulding machine. Box P415, care of "Plastics." 141-9

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We hold large stocks of acetate in clear and colours, 3 thou. to 40 thou.

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P.V.C. offcuts and scrap. Manufacturers are interested in purchasing clean scrap and offcuts, particularly natural, direct from makers-up. Substantial regular quantities required. Please send samples with particulars of price and approximate quantities for a continuous contract, to Box P4122, care of "Plastics." 143-729

Raw Material Available and Wanted (contd.)

Required urgently, polystyrene powder, virgin or regrounded, preferably pastel colours; good price paid. Reply Box P4116, care of "Plastics." 142-728

"Perspex" offcuts. Required, large or small quantities. Please write, J. E. Hoare (O.T.S.), Ltd., 134-144 High Street, S.W.17. 144-732

Wanted, "Perspex" offcuts, coloured and clear, suitable for handicraft work. Please send samples, price, to Arts and Crafts (Doncaster), Ltd., West Laith Gate, Doncaster. 142-734

J. H. Berry (Plastics).

Recognized stockholders of "Perspex" acrylic sheet. Large and varied stocks in clear and coloured always on hand.

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Michael S. Stevens. Regular clearance of scrap plastics, metals and factory wastes. Ormond Road, Richmond, Surrey. Phone 0211. zzz-247

Accurate powders for ceramic, alloy, plastic, paint, etc., industries. Dohm, Ltd., Pulverisers, 167 Victoria Street, London, S.W.1. zzz-248

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 and 40, inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Mould-maker—Die-sinker in hard and soft metals wanted by old-established firm producing blown toys and fancy goods in thermo-plastic materials. Excellent opportunity and permanency for good man., Apply Box P4016, care of "Plastics." 141-643

Works manager required for old established company near London. Only applicants with experience in the plastic industry and knowledge of administration and production control would be considered. Applicants should be under 40 years of age. Fullest particulars, salary, etc., to Box P407, care of "Plastics." 141-638

Works chemist required by plastic moulders principally interested in thermosetting materials. Only applicants with honours degree who have had experience in the industry and who are under 40 years of age will be considered. Fullest particulars, salary, etc., to Box P408, care of "Plastics." 141-639

Chemical engineer required by large firm of plastic moulders near London to take charge of development. Only applicants with experience in the industry who are under 40 years of age will be considered. Full particulars, salary, etc., to Box P409, care of "Plastics." 141-640

Senior mould designer required for the plastic industry. Experience and design of compression and transfer type moulds who will act at the same time as plant superintendent of a tool room. Only men with extensive experience in this class of work need apply in writing, stating experience, age and salary required to Box P4010, care of "Plastics." 141-641

Working foreman required for tool room. Fully conversant with production of compression and transfer-type moulds for the plastic industry. Only men with extensive experience in this class of work need apply in writing, stating experience, age and salary required to Box P4011, care of "Plastics." 141-642

Technical sales representative, part time, for London and Greater London required by well-known Birmingham toolmakers. Knowledge of and contacts with plastics and/or die-casting industries essential. Apply with full details of age, experience, commission required, etc., to Box P4117, care of "Plastics." 141-19

Situations Vacant (contd.).

Established plastic moulders require services of first-class agents or travellers in following areas:—London, Birmingham, Leeds, Manchester, Liverpool, Glasgow and Scotland. Must have good connections with wholesalers. Write, giving particulars of experience in first letter. Box A4812, Williams's Advertisement Offices, Bradford. 141-x1376

Live-wire salesman required with first-class connection in wholesale button and costume jewellery trade. Good prospects. Salary and commission. Box P4114, care of "Plastics." 141-13

Man required to develop a department for the sale of plastic tubing, made by an entirely new process. Apply in first instance to Box P413, care of "Plastics." 141-11

Charge hand required with knowledge of injection and compression moulding. Write, stating experience and salary required. Box P416, care of "Plastics." 141-8

Working foreman, plastic moulding (compression), required by small firm in Essex. Shift work entailed. Permanent and well-paid position for the right type of man. Send fullest details and wages required to Box P419, care of "Plastics." 141-5

Wanted, young sales manager, already known to the injection moulding industry, to take complete charge of the sales organization of a large cellulose acetate and P.V.C. manufacturing company. Excellent prospects for the right man. Box P4111, care of "Plastics." 141-3

Physicist required to take charge of Physical Testing Laboratories, concerned with the evaluation and testing of plastics and rubber-like polymers. Sound knowledge of electrical, physical and dynamic test methods essential. Applicant must possess good organizational abilities and be capable of arranging and supervising the routine work of a team of young assistants and developing new methods of testing.
Applicants, who should be between 25 and 35 years of age, and possess a 1st or 2nd Class Honours B.Sc. Degree, should apply, in the first instance, to the Controller of Research and Development, The Distillers Co., Ltd., 21 St. James's Square, London, S.W.1. 142-130

Vacancies exist in the Distillers Co., Ltd., Research Organization for two organic chemists for development work on plastics manufacture. Applicants should be under 26 years of age and possess a B.Sc. Degree, or equivalent, in Chemistry. Commencing salary will depend upon age, qualifications and experience.
Applications should be submitted in the first instance to the Controller of Research and Development, The Distillers Co., Ltd., 21 St. James's Square, London, S.W.1. 142-731

SITUATIONS WANTED

Energetic and ambitious planning manager, 20 years' comprehensive production experience with large plastics company, seeks post as production or planning manager. Box P4124, care of "Plastics." 141-x1735

Plastic moulding specialist with wide engineering and office experience up to board level seeks position of responsibility; is especially qualified to initiate new factory or re-establish unsatisfactory business. England, Australia or South America preferred, but would consider any proposition offering suitable reward for unusual effort. Box P4125, care of "Plastics." 141-x1559

Situations Wanted (contd.)

Engineer, with many years of experience in all branches of plastic articles, desires to represent in Australia all types of plastic materials, machines and raw materials. Is willing to establish and manage such factory. Farkas, 19, Rue Copernic, Paris, 16E. France. 141-x1375

Spare-time work required in plastics by industrial designer, three years' training, 18 months in plastics trade. Apply, Box P4125, care of "Plastics." 141-21

Process and development engineer seeks change, experience, low-pressure polyester-type resins. Box P411, care of "Plastics." 141-x830

TIME RECORDERS

Factory time recorders. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 149-544

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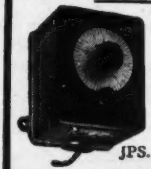
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